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PRINCIPAL INVESTIGATOR:
John Karduck, MD

CONTRACTING ORGANIZATION:
Conemaugh Valley Memorial Hospital
Johnstown, PA 15905

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John Karduck, MD

Email: JKarduc@conemaugh.org

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14. The MIDHT project in Year 1 focused on three (3) distinct but related arms of research and development involving health information technology (HIT) and health information exchange (HIE) capabilities within a rural healthcare system in Southwestern Pennsylvania. The goal was to empower both providers and patients with technologies aimed to improve the quality and coordination of care, reduce medical errors, promote patient safety and reduce overall healthcare costs. Many lessons were learned in deploying a HIE testbed infrastructure for data exchange between Conemaugh Health System (CHS) facilities and externally with the Department of Defense (DoD). Video teleconferencing (VTC) proved effective in delivering exercise and nutrition information to a metabolic syndrome population whereas online journal usage steadily declined over the course of one year. A manuscript detailing Personal Health Records (PHR) was successfully accepted for publication.

15. SUBJECT TERMS
Health Information Exchange | Electronic Health Record | DoD Interoperability
Consumer Informatics | Metabolic Syndrome | Video Teleconferencing

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Introduction

The Military Interoperable Digital Hospital Testbed (MIDHT) is a five-year program of research to develop a real-world testbed environment in Southwestern PA (SW PA), the purpose of which is to research and evaluate Health Information Network (HIN) and electronic health record (EHR) services and technologies that make health information readily available to consumers, the Military Health System (MHS) and private sector rural providers, which may be TRICARE Providers. The MIDHT defined requirements and tested innovative solutions to optimize healthcare access for rural communities, and identified lessons learned/best practices that benefit both the MHS environment and stakeholders in SW PA. The Department of Defense (DoD) and Conemaugh Health System (CHS) have common requirements for health information exchange (HIE), connecting disparate systems and providers, and enabling secure communications between providers and consumers. There is minimal evidence regarding business, clinical and technical solutions for health information technology (HIT) in rural communities. The MIDHT will explore the use of HIE and EHR services and technologies across three (3) unique but related arms of research, with one task for each arm:

Arm 1: Longitudinal Study for the Use of Interoperable Accessible Health Information Exchange Services and Technologies in Rural Communities

This arm focused on how a rural environment can utilize HIN services and technologies to promote interoperability between disparate entities such as TRICARE Providers, private health systems, and DoD facilities. MIDHT investigated attitudes, usability, and effectiveness of HIN services by rural providers, to include business practice changes related to use of HIE tools by provider groups, TRICARE Providers, and the three (3) CHS facilities. Baseline research initiatives within this arm focused on readiness, perceptions, and attitudes towards electronic medical records and health information exchange, provider workflow and productivity analysis before EHR implementation and the current state of health information exchange between TRICARE providers and DoD. This HIN services infrastructure will be progressively enhanced and refined during the course of the project.

Arm 2: The Impact of Consumer Informatics in the Chronic Care Model: Metabolic Syndrome in a Rural Setting

This arm concentrated on consumer informatics and community outreach in the rural environment by extending the boundaries of the hospital "brick and mortar" structure to patients in rural SW PA; by exploring HIE solutions and services that maximize patient and non-physician provider interactions and patient outcomes. This arm viewed the problem from two different perspectives. The first perspective will assist providers in outreach activities (e.g. chronic disease prevention of diabetes) via videoconferencing technology to deliver a lifestyle intervention program to enrolled research subjects. A second perspective provided enrolled research subjects with an online nutrition and fitness journal to allow for daily input of food consumption and exercise. Measures collected during testbed activities focused on provider acceptance and usability, consumer acceptance, usability and self-management, and clinical health status changes using health information technology tools and services.

Arm 3: Department of Defense: Consumer Informatics & HIE tools in the MHS

This arm focused on the emergence of personals health records (PHRs) in the healthcare industry as an electronic tool to connect hospitals, providers, patients, insurers and governmental agencies. Research staff performed a traditional literature search and fact finding through product demonstrations, educational webinars and news releases. A PHR manuscript was submitted to the *Journal of Rural Health* for publication on 14 April 2009 and was rejected. The manuscript was then submitted to the *Journal of Telemedicine and E-Health* on 13 May 2009. Revisions were requested by the editors on 18 June 2009. Revisions were submitted and **accepted** for publication on 16 September 2009. Manuscript (refer to Appendix A) will be published in the March 2010 issue. An evaluation of PHRs in a military setting(s) did not materialize as initially planned by Conemaugh and TATRC representatives.

Statement of Work

Task 1. (Arm 1) Examine and Demonstrate the Viability of a Health Information Exchange (HIE) and Lightweight Electronic Health Record (EHR) Capability Based on a Health Information Network (HIN) Services Model in a Rural Setting

Subtask 1.1. Design**,** implement and deploy a service-based HIE infrastructure and services to support exchange of data in a rural setting.
Subtask 1.2. Design, implement and deploy a testbed research framework that supports the evaluation of HIE technologies in a rural setting.
Subtask 1.3. Compare the effectiveness of a service provider-based oriented HIE and lightweight EHR implementation to more traditional EHR and electronic medical record (EMR) implementations, both in the rural and urban settings.
Subtask 1.4*:* Using a longitudinal study design, assess changes in provider workflows and efficiency resulting from use of an HIE capability.
Subtask 1.5. Research, examine, and demonstrate the value of interoperability between private sector facilities, TRICARE Network Providers (TNPs), Military Treatments Facilities (MTFs), and Veterans Affairs (VA) facilities that will better support MHS goals.
Subtask 1.6. Assess the potential use of Government off the shelf (GOTS) technologies (e.g. Theater Medical Information Program (TMIP), Battlefield Medical Information System-Tactical (BMIST)) for rural health.

Task 2. (Arm 2) Consumer Informatics & Community Outreach in Rural Settings

Subtask 2.1 Develop, test and deploy HIE tools for patient and community outreach in rural environments.
Subtask 2.2 Research findings on behavior, knowledge level, & health status changes in diabetics and other select populations of interest in Civilian and DoD settings.
Subtask 2.3. Research, develop and deploy online Diabetes Self Management Education (DSME) content and eVisit/SMS capabilities to positively impact consumer health status and behaviors in a rural healthcare setting.
Subtask 2.4. Investigate HIE tools' impact on providers' activities and workload compared to traditional healthcare, health education and patient/provider communication.
Subtask 2.5. Evaluate changes in business processes, workflow and return on investment (e.g. reimbursement) related to extending services to other rural areas.

Task 3. (Arm 3) Department of Defense Consumer Informatics & HIE tools in the MHS

Subtask 3.1 Research the impact of eVisit/SMS and other select HIE services and digital tools on MHS healthcare business practices and patient outcomes.
Subtask 3.2 Test/Research patient authentication approaches & methods.
Subtask 3.3 Assess opportunity for Technology Transfer of GOTS HIE tools to the private sector.
Subtask 3.4 Assess applicability of lessons learned with Armed Forces Health Longitudinal Technology Application (AHLTA) and HIE tools for rural environments.
Subtask 3.5. Examine changes in MHS beneficiaries' consumer behavior and health status due to consumer use of web-based healthcare technologies, tools, and/or information.
Subtask 3.6. Measure the use of HIE tools and technologies in private and MHS sectors to promote consumer focused healthcare across the DoD.

Body

SW PA offers an ideal testbed for evaluating the effectiveness of applying an HIN services infrastructure. The CHS is the primary source of healthcare services in Somerset and Cambria counties, which services primarily a rural population around Johnstown, PA. This system has one tertiary care facility-- Memorial Medical Center (MMC), and includes relatively small facilities for secondary care: Miners Medical Center (MiMC) to the north and Meyersdale Medical Center (MyMC) to the south, which is also a designated Critical Access Hospital. There are over 100 primary care and specialist physicians in the Conemaugh Physician Group (CPG) network. Project specific sites for EHR implementation within CPG include Portage Health Center and NORCAM Community Health Center.

CHS offers a continuum of care, from highly specialized services such as a Level 1 Regional Resource Trauma Center and a Level III neonatal intensive care unit to award-winning community wellness and clinical care. CHS offers seven physician residencies and strong research affiliations with government and academic partners. CHS has almost 5,000 employees, more than 350 physicians (active and courtesy) and more than 800 licensed patient beds.

Rural Landscape

- Little or no IT infrastructure in rural hospitals and physician offices
- Access to healthcare resources lacking in rural communities outside of Johnstown
- Aging population, higher risk for chronic diseases
- Physician recruitment a major challenge
- Rural providers may feel isolated due to varying factors
- Emergency Room visits increasing rapidly (MMC: 70,644 – FY 2008)
- Lack of high-speed internet/technical support in rural areas
- Capital investment is limited
- Patients may travel long distances to seek care

Arm 1: Longitudinal Study for the Use of Interoperable Accessible Health Information Exchange Services and Technologies in Rural Communities (Subtasks 1.1 – 1.6)

The following technical objectives of MIDHT have been achieved in order to help close the gaps of delivering clinical data to providers across a rural health care system, which also provides the infrastructure to research and evaluate the respective technologies:

A. Wide Area Network (WAN): Provide high-speed connectivity to three rural facilities in order to exchange healthcare information more efficiently.

MMC contracted with Verizon to provide 100mbps (Ethernet private Line service) to Miners Medical Center and 45mbps DS3 service to Meyersdale Medical Center in October 2007. All required Cisco networking switching/routing gear was awarded in February 2008. Both circuits were installed, tested, cutover and fully operational in June 2008. Additionally, CVMH contracted with Verizon to provide 10mbps (Ethernet private Line service) to Portage Health Center in April 2007. Portage circuit was installed, tested, cutover and fully operational in August 2008. NORCAM physician office is utilizing existing T1 circuit as well as a separate VPN for scanning. Finally, wireless access points were installed at Portage and NORCAM to further enhance EMR usability.

B. Enterprise Master Patient Index (EMPI): To build a complete longitudinal health record for patients within Conemaugh Health System and necessary for interfacing with multiple databases and applications.

The MIDHT project team reviewed several EMPI options and signed a contract with Initiate. The onsite project kickoff and selection of team members was held in early February 2008. Previous discussions included configuration and data sources necessary for project success. MPI extracts from Memorial, Meyersdale, Miners, and CHI were created and submitted to Initiate for their validation and analysis. During three-day training, HL7 specifications were developed and agreed upon. MIS team completed a threshold analysis to determine how matching will be handled by the identity hub to prevent duplicates and overlays. Equipment requirements were defined in conjunction with vendors and respective hardware and O.S. software was received, staged and installed in CHS data center in March 2008.

In April 2008, the software was loaded on the onsite server and new data extracts from all sources created using live data. In May 2008, HL7 feeds from all live sources via Cloverleaf and Data Connect were created and tested and verified by Initiate. In late May, detailed testing began and continued through June with any problems being resolved as they were identified. The enterprise ID's being generated by the identity hub were tested using the test Portal database and data from the EID Change Broker and Mapping Broker. On June 27, 2008, the final backload of the MPI data from all sources was created and loaded onto the live Initiate servers. All live HL7 feeds were also started. Initiate EMPI went live across Conemaugh Health System facilities on July 1, 2008. Shortly thereafter, CVMH signed off on the conversion to live and also transitioned to Initiate live support. In early August 2008, Initiate SDK product was installed

and functional. This provided an API into the Initiate database. Finally, Conemaugh Physician Group patients were added as a new source in October 2008, bringing the total sources to five.

Please see Appendix B for the technical architecture and screen shot.

Total Records	
Memorial Medical Center:	339,010
Miners Medical Center:	46,936
Meyersdale Medical Center:	24,804
Rural Health Clinics:	39,964
Conemaugh Physician Group:	174,432
Total:	625,146
Unique:	413,042

C. Patient Folder: Install complete inpatient post-discharge electronic medical record at two rural hospitals.

The MIDHT project team decided to extend the McKesson Patient Folder application to Meyersdale Medical Center and Miners Medical Center as it previously was implemented at the tertiary care facility, Memorial Medical Center. Therefore, a contract was signed with McKesson to finalize Patient Folder for the respective hospitals. McKesson consulting resources were on-site to establish the project plan and resource allocation. Site visits to both facilities occurred early on to evaluate workflow. Workflow builds began in February 2008 and continued through April 2008. Equipment requirements were defined in conjunction with vendors and respective hardware and O.S. software was received, staged and installed in CHS data center in May 2008.

In May 2008, training occurred on the McKesson inpatient EMR system with MyMC staff and physicians. Patient Folder went "live" at MyMC on June 9, 2008. Site visits to MyMC occurred to support installation and troubleshoot any issues. Site visits also occurred at MiMC to review and complete workflow analysis. Training with MiMC staff and physicians occurred over the summer months. This installation was split into two phases; phase I (business functions) went "live" during the month of June 2008. Softmed transcription installation was necessary before Patient Folder went fully "live" at MiMC on September 1, 2008. MIS staff provided on-site support as needed to resolve any outstanding issues.

Please refer to Appendix C for multiple screen shots.

D. Interface Engine: Pathways interface manager provides interface management consolidation, protocol conversion for application to application connectivity and error tracking/recovery services.

It was determined that the McKesson Cloverleaf Interface Engine (aka Cloverleaf) is required to meet the capacity and functional needs of HIE interoperability and EMPI associated with MIDHT. In January 2008, hospital interface engineer, Darren Tomlinson, attended Level 2 training. Conversion of Datagate interfaces to Cloverleaf on existing single server Cloverleaf environment was completed. Conference calls with McKesson occurred to plan our conversion to a high availability Cloverleaf solution. In February 2008, the hardware was agreed upon and the configuration was decided to be a cold standby instead of complete high availability. This was both more cost effective and would also make future upgrades much easier. In April 2008, the hardware was connected to the SAN and McKesson was given VPN access to the new servers to begin their interface conversion from the single Cloverleaf environment to the dual environment.

During the month of May 2008, it was determined that the servers were not properly staged, which caused a delay in the project. Therefore, McKesson PIM services backtracked and decided to install the latest Cloverleaf version 5.5. All interfaces thus were converted from Datagate to Cloverleaf, on the single server instance.

In July 2008, McKesson implementation team installed patches and software. McKesson copied over current live environments to the new servers. Powerpath server cold failover testing was performed and initial connectivity testing performed on test interfaces. CVMH also debugged issues with port number assignment limitations when running in Linux. In September 2008, McKesson Cloverleaf made generally available version 5.6. Decision was made to upgrade to version 5.6 before initial “live” deployment. Additionally, CVMH upgraded to the latest Linux OS version 5.

The Cloverleaf 5.6 upgrade was completed in October 2008 with testing of all major interfaces completed in early December 2008. A copy of all live interfaces from the current platform to the Cloverleaf 5.6 platform and subsequently “live” implementation was completed in January 2009.

There are currently 80 interfaces live on the Cloverleaf engine. These interfaces include ADT and scheduling from 6 different sources. Orders, results and charges from multiple ancillary systems are feeding physician portals and physician office electronic medical records.

Please refer to Appendix D for Cloverleaf interface threads.

E. Ambulatory Electronic Health Record: Install Allscripts Touchworks in two CPG physician offices (Portage & NORCAM).

The MIDHT team analyzed several EMR vendors and signed a contract with Allscripts. An EMR Evaluation Report was delivered to TATRC on June 26, 2008 as a contract deliverable. In February, an Implementation Coordinator was assigned by Allscripts and weekly project calls began shortly thereafter to identify project teams, roles and responsibilities. In March, a webinar was conducted on Touchworks knowledge base for the MIS directors. This is a website that provides resources to supplement ITT training as well as best practice references and access to monthly updates. Equipment requirements were defined in conjunction with vendors and respective hardware and O.S. software was received, staged and installed in CHS data center in April 2008.

Seven team members attended ITT training in Chicago from 28 April – 2 May, 2008, including Dr. Karduck (Principal Investigator/Portage Health Center) and Dr. Lieb (NORCAM Community Health Center). On May 12, 2008, a project kickoff meeting occurred with Allscripts. Two weeks later, members of Allscripts were on site in Johnstown for initiation of design and build phase. Current workflow analysis of the two physician office locations was completed by MIS staff.

During the summer months of 2008, EMR build and testing of ADT, results and orders was initiated. Additionally, MIS trained the respective office staffs in scanning and backload of information. Office equipment, including workstations and scanners, was analyzed, purchased and installed. Notebooks and related accessories were deployed before "live" implementation.

MIS staff attended advanced note build training in Chicago in late October 2008. Core team actively worked on build of Note, Order/Result and Charge modules, as well as Charge interface. Organization structure was converted from single org to multi-org sharing. Registration and scheduling interface implementation delayed due to functionality issues between Initiate Systems Enterprise Master Patient Index and Allscripts Touchworks EHR (refer to "Lessons Learned" section for more information), which pushed back the implementation timeline. Core team actively worked with Allscripts management-level resources (including product, interface, and database managers) and Initiate Systems on a reasonable resolution of enterprise identification functionality issues. Notebooks were deployed to Portage and NORCAM in November 2008.

The Orders/Result interface build has been completed and testing was underway in April, 2009. Results for laboratory tests preformed at any of the three (3) CHS hospitals are immediately sent to the Touchworks EHR and are available for physician review. Below is an example of laboratory results as they appear in the Touchworks EHR. We also entered the early stages of building a Results Interface to send radiology reports as well as other transcribed documents such as physician consultations, history and physicals, and operative reports that are dictated and transcribed at CHS hospitals to the EHR.

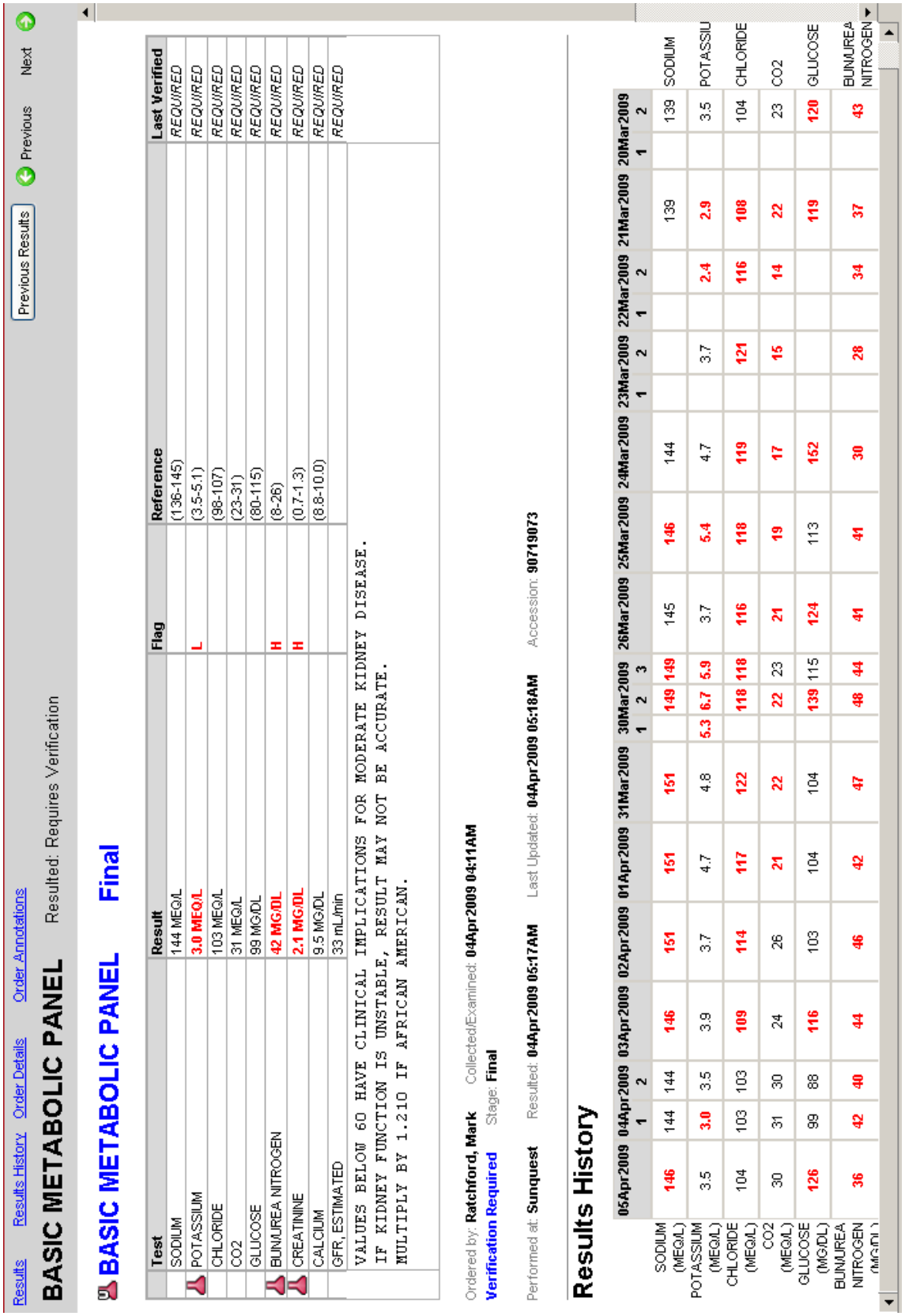
The project team continued to work with the two physician champions to complete the note build and system setup. Results flowing into Touchworks EHR were reviewed by the physician champions and it was suggested that the large volume of results received needed a method to

manage. MIS programming staff developed a matrix to allow physicians to filter results based on patient type, physician/patient relationship, and result type based on each physicians' preference. The matrix was demonstrated to the physician champions and met their approval for managing results.

MIS analyst team provided refresher training and equipment testing to the pilot offices for Wave 1 modules, which include Base, Document, Scanning and the activation of GE IDX interface in the live environment. Office staff with the assistance of MIS analysts began scanning pertinent clinical data and entering historical patient data such as problems/medications/allergies into Touchworks as of mid December 2009.

Drs. Karduck and Lieb began training sessions for the additional physicians at NORCAM and Portage in January 2010. The training consisted of two 3.5 hour sessions with practice activities between sessions to familiarize the physicians with the software and workflow process. Wave 2 will include physician notes, results, orders, and electronic prescribing and will "go live" on February 16th at Portage and March 2nd at NORCAM.

Figure 1 - Test Interfaced Lab Results



Results | Results History | Order Details | Order Annotations

Previous Results | Previous | Next

BASIC METABOLIC PANEL

Resulted: Requires Verification

BASIC METABOLIC PANEL Final

	Test	Result	Flag	Reference	Last Verified
	SODIUM	144 MEQ/L		(136-145)	REQUIRED
	POTASSIUM	3.0 MEQ/L	L	(3.5-5.1)	REQUIRED
	CHLORIDE	103 MEQ/L		(98-107)	REQUIRED
	CO2	31 MEQ/L		(23-31)	REQUIRED
	GLUCOSE	99 MG/DL		(80-115)	REQUIRED
	BUN/UREA NITROGEN	42 MG/DL	H	(8-26)	REQUIRED
	CREATININE	2.1 MG/DL	H	(0.7-1.3)	REQUIRED
	CALCIUM	9.5 MG/DL		(8.8-10.0)	REQUIRED
	GFR, ESTIMATED	33 mL/min			REQUIRED

VALUES BELOW 60 HAVE CLINICAL IMPLICATIONS FOR MODERATE KIDNEY DISEASE.
IF KIDNEY FUNCTION IS UNSTABLE, RESULT MAY NOT BE ACCURATE.
MULTIPLY BY 1.210 IF AFRICAN AMERICAN.

Ordered by: **Ratchford, Mark** Collected/Examined: **04Apr2009 04:11AM**
Verification Required Stage: **Final**

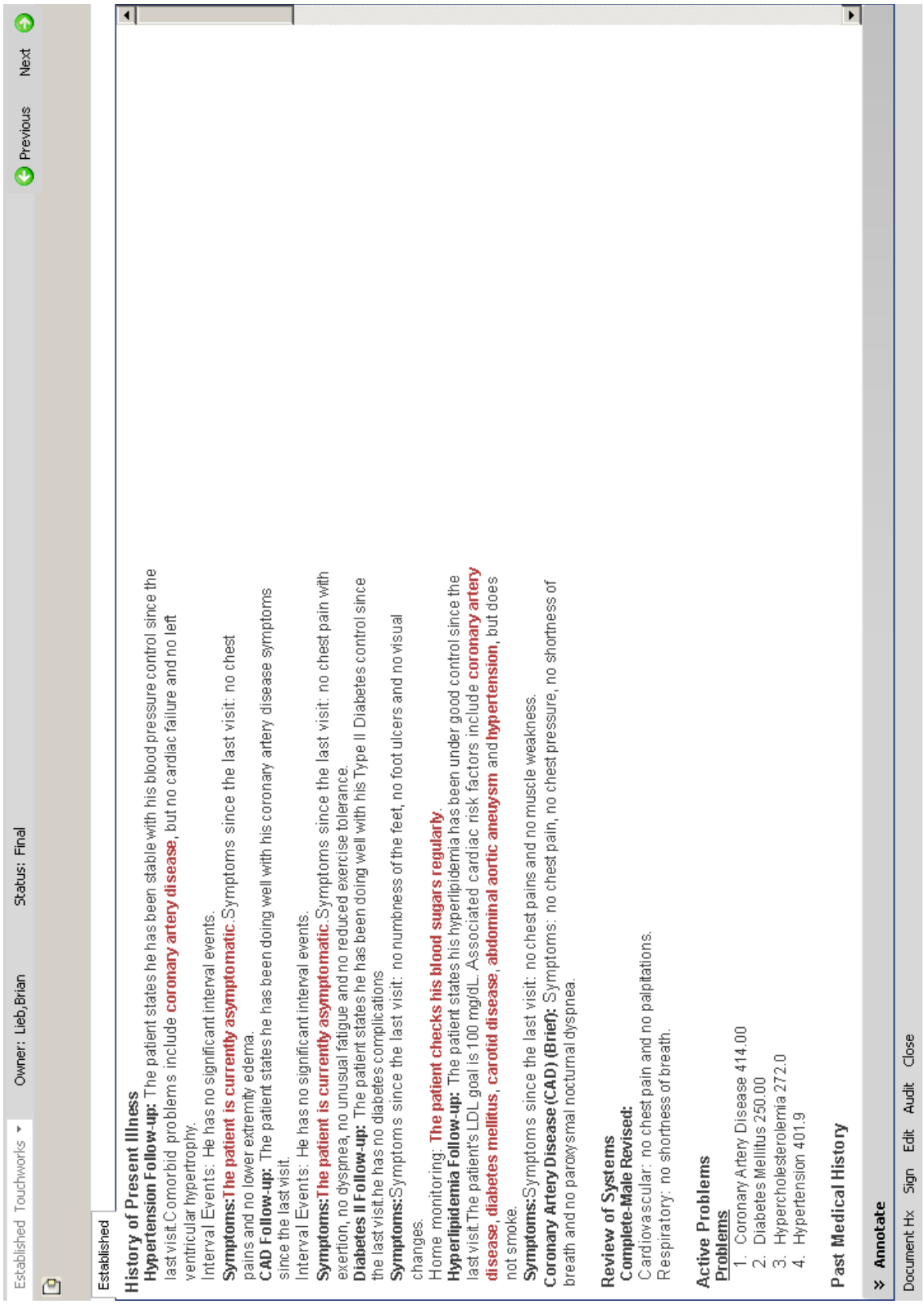
Performed at: **Sunquest** Resulted: **04Apr2009 05:17AM** Last Updated: **04Apr2009 05:18AM** Accession: **90719073**

Results History

	05Apr2009	04Apr2009 1	04Apr2009 2	03Apr2009	02Apr2009	01Apr2009	31Mar2009	30Mar2009 1	30Mar2009 2	30Mar2009 3	26Mar2009	25Mar2009	24Mar2009	23Mar2009 1	23Mar2009 2	22Mar2009 1	22Mar2009 2	21Mar2009	20Mar2009 1	20Mar2009 2	
SODIUM (MEQ/L)	146	144	144	146	151	151	151		149	149	145	146	144					139		139	SODIUM
POTASSIUM (MEQ/L)	3.5	3.0	3.5	3.9	3.7	4.7	4.8	5.3	6.7	5.9	3.7	5.4	4.7		3.7		2.4	2.9		3.5	POTASSIU
CHLORIDE (MEQ/L)	104	103	103	109	114	117	122		118	118	116	118	119		121		116	108		104	CHLORIDE
CO2 (MEQ/L)	30	31	30	24	26	21	22		22	23	21	19	17		15		14	22		23	CO2
GLUCOSE (MG/DL)	126	99	88	116	103	104	104		139	115	124	113	152					119		120	GLUCOSE
BUN/UREA NITROGEN (MG/DL)	36	42	40	44	46	42	47		48	44	41	41	30		28		34	37		43	BUN/UREA NITROGEN

The project team worked aggressively with the two physician champions on the note build and system setup. There was significant progress in identifying workflows and processes. A sample note for a patient visit can be seen below.

Figure 2 – Test Physician Note



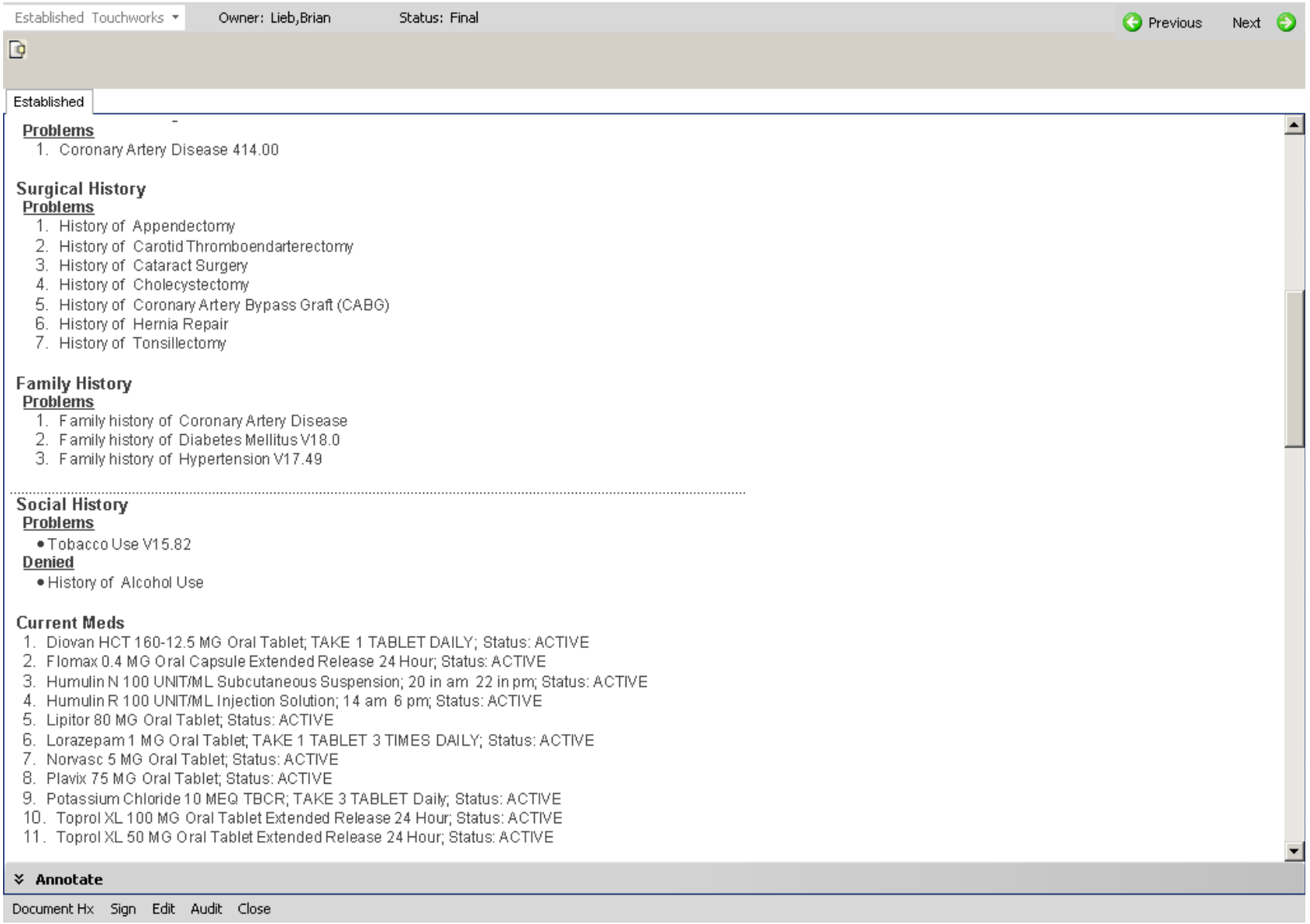


Figure 3 – Test Physician Note

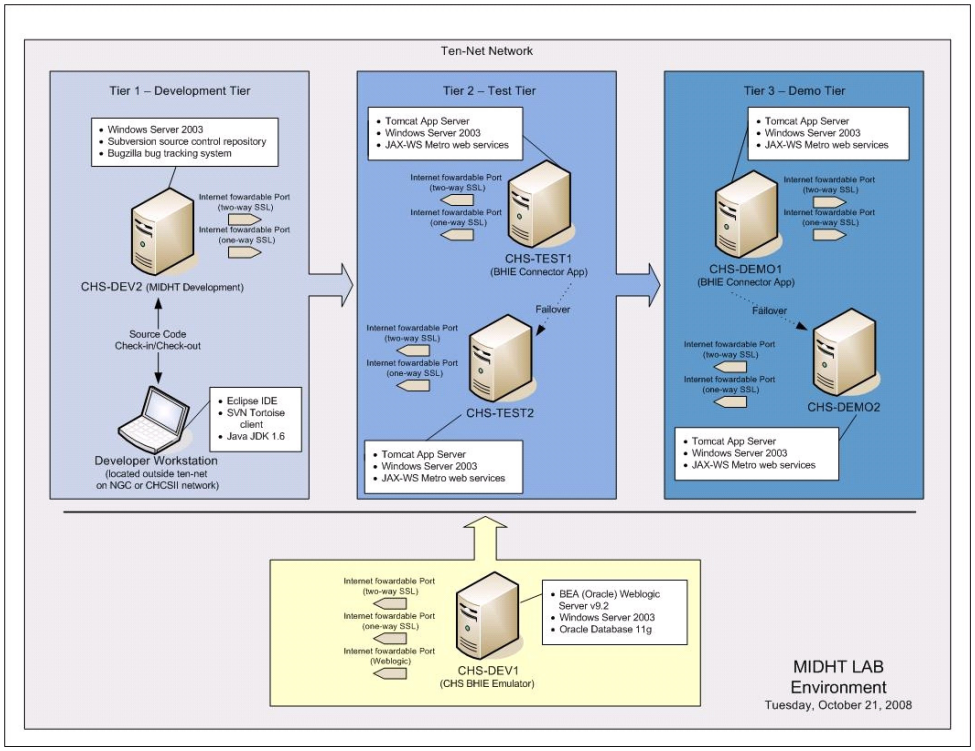
F. Health Information Exchange (HIE) w/ DoD: Initiate, test, and deploy portal technology in order to electronically exchange test health information contained within the DoD system to private sector rural physicians. This work was completed by subcontractor Northrop Grumman Information Technology in conjunction with CHS. Technical Architecture Design Document was re-submitted to TATRC on February 27, 2009.

CHS Portal Development - Northrop Grumman Specific

- Johnstown Northrop Grumman personnel began the process of gathering portal specific requirements in late February 2008, including a demonstration of Conemaugh's Care Portal and McKesson Horizon Patient Folder.
- Initiated daily status meetings on July 21, 2008. These meetings are attended by key technical Northrop Grumman MIDHT personnel and included a status check where the team provides updates about progress made and any issues that need to be resolved. The meetings help to provide a daily focus on the development work being done.

  — Held several WebEx's on topics that included an overview of work that has been done on the five (5) web service calls, an overview of the BHIE Framework, and a code review session.
- Continued work on the configuration of the MIDHT development and production enterprise architecture. The six servers that make up the architecture were configured with external IP addresses to allow for inbound/outbound connections with Covisint. In addition, the ports that Covisint used to connect to applications that reside on the servers were made available through the external IP addresses.

Figure 4 – MIDHT Lab Environment



- Completed configuration of the local (Johnstown) development environments. This allowed the developers in the Johnstown office to develop code locally.

Developed and implemented the Federal Health Record Access Service (FHRAS). Functioning as the primary broker of information exchanged between the Covisint portal and BHIE services, the FHRAS provides patient specific reports and results to the Patient Dashboard of the CHS Portal. Areas of development undertaken by Northrop Grumman:

- Accept a request for patient information from the Covisint portal by publishing and securing web services designed to be invoked by code residing within the Covisint Portal
- Receive a patient information request as a SOAP payload that contains a HL7v3 message and transform the message into a SOAP request that can be understood by the BHIE services
- Initiate a web service call to the BHIE Services and process the document and/or XML message contained within the response payload
- Transform received messages and/or documents into a HL7v3 format and return to Covisint
- Developed Patient Correlation code within the FHRAS. The code accepts an HL7v3 request, transforms the request, and then forwards the request to the BHIE services. Once received by the BHIE services, the patient is correlated across pertinent domains within the BHIE architecture and a response acknowledging the receipt of the request is returned.
- Worked in conjunction with Covisint to develop the 5 web service calls required to return Discharge Summaries, Clinical Notes, Medications, Radiology Reports and Labs within the CHS Portal. Java JAR files that contain web service client classes, WSDL files and XML XSD files were provided to Covisint to facilitate the invoking of web services published by the FHRAS. The contents of the JAR files also support Subject Discovery (Add Patient) and SAML security.

- Northrop Grumman personnel attended Portal specific training on September 17, 2008. This training enables the Johnstown personnel to effectively administer the portal, as well as act as first-line support.

CHS Portal Development – Covisint Specific

A teleconference was held on March 25, 2008 with Northrop Grumman and CHS personnel to begin discussions regarding the use of the Covisint Platform as a collaboration environment. Services offered by Covisint include: a clinician portal, an administrative portal, a federated security model, and a messaging hub. These components support the HIE and EHR-related capabilities set forth in the CHS/Northrop Grumman statement of work (SOW).

A meeting was held on April 11, 2008 in Johnstown involving Northrop Grumman, CHS and Covisint personnel. The meeting was requested by CHS for Covisint to provide greater details on their architecture and functionality.

A demonstration of the CHS Portal was given by Northrop Grumman personnel to the CHS MIDHT team on June 18, 2008.

The SOW between Northrop Grumman and Covisint was signed on June 30, 2008, and a fully executed copy was delivered to CHS.

CHS provided web service interfaces for CHS's Initiate EMPI – supporting patient search, identification, and retrieval capabilities through the CHS Portal.

Implemented connectivity and web service interfaces to NGC's FHRAS – supporting the query for and retrieval of DoD test data – as described in previous section.

Initiated weekly status update meetings in July 2008 to monitor the progress of the CHS Portal development effort. Meetings were attended by Northrop Grumman, CHS and Covisint personnel. Each week the timeline, project plan and project log were discussed.

- Several requirements gathering sessions were held involving Northrop Grumman, CHS and Covisint personnel. Topics of discussion included search fields and results screens, audit trail capabilities, web service calls, portal administration, and security access.

Configuration Management Activities

- Initiated weekly internal Configuration Management (CM) meetings in April 2008 to begin to develop MIDHT specific CM processes and procedures.

- A draft CM Plan was created by an internal MIDHT CM team and reviewed by Northrop Grumman personnel.

- Finalized CM Plan on June 20, 2008. Comments and suggestions from Northrop Grumman personnel were incorporated in final document.

- Several meetings, as well as a WebEx, were held by the MIDHT CM team in September 2008 to aid in determining the most appropriate configuration for

Bugzilla, the defect-tracking tool being utilized for the MIDHT project. Configuration of the production instance began shortly thereafter.

CHS/Northrop Grumman Weekly Update Meetings

- Beginning June 5, 2008, initiated weekly update meetings attended by Northrop Grumman staff from several facilities as well as CHS representatives.

- On August 7, 2008, CHS gave a HIPAA presentation to the Northrop Grumman Johnstown personnel. After the presentation, Northrop Grumman personnel demonstrated the CHS Portal to provide a level of understanding about the portal's capabilities and in ensuring that the portal meets CHS HIPAA requirements once live data is exchanged.

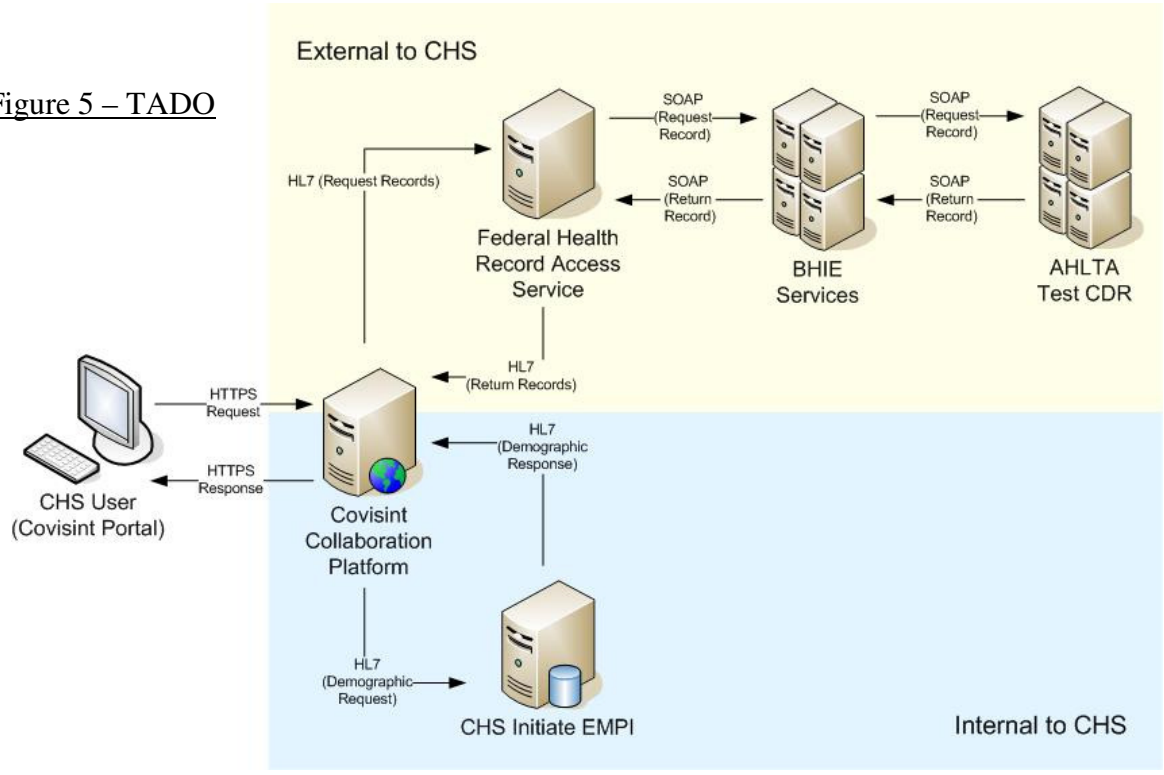
AHLTA Test Instance

As a developer for the DoD's electronic health record, AHLTA, Northrop Grumman has created a test environment that simulates the AHLTA structure. This includes CHCS servers interacting with AHLTA to provide patient demographics and demonstrate how medications, laboratory, radiology tests, etc… are requested. The test instance also has identified patients that have simulated VA data as well; this provides the opportunity to replicate the BHIE capability as displayed in AHLTA.

Technical Architecture Design Overview (TADO)

Phase one of implementing a service-oriented architecture for the MIDHT BHIE addresses interfaces between the Covisint Collaboration Platform and CHS, as well as the flow of information shared by Covisint and the DoD. The following diagram outlines the exchange of test data at the conclusion of Phase One, which was completed on October 29, 2008 after technical issues were resolved.

Figure 5 – TADO



The Covisint Portal Service provides a web-based portal that enables users to access patient records, conduct searches, review targeted bulletins, manage documents and manage content. The customizable Java Specification Request (JSR)-compliant portal environment allows a user to securely access other areas of the MIDHT BHIE through a Secure Socket Layer (SSL) connection. Figure 6 illustrates the different areas of the Web 2.0 portal environment.

The "My Practice" tab allows authorized users to access patient data from the test DoD system. Users can search on the following fields in order to return a patient match but must include SSN or First and Last Name (see Figure 7):

- First Name
- Middle Name
- Last Name
- Date of Birth
- Social Security Number (SSN)
- Phone Number
- Zip Code

Once a patient has been correctly matched in both test systems, the following data types are viewable from the "Records Portlet" (see Figure 8):

- Discharge Summary
- Clinical Notes
- Medications
- Radiology Reports
- Lab Results

Figure 6 – Covisint Portal

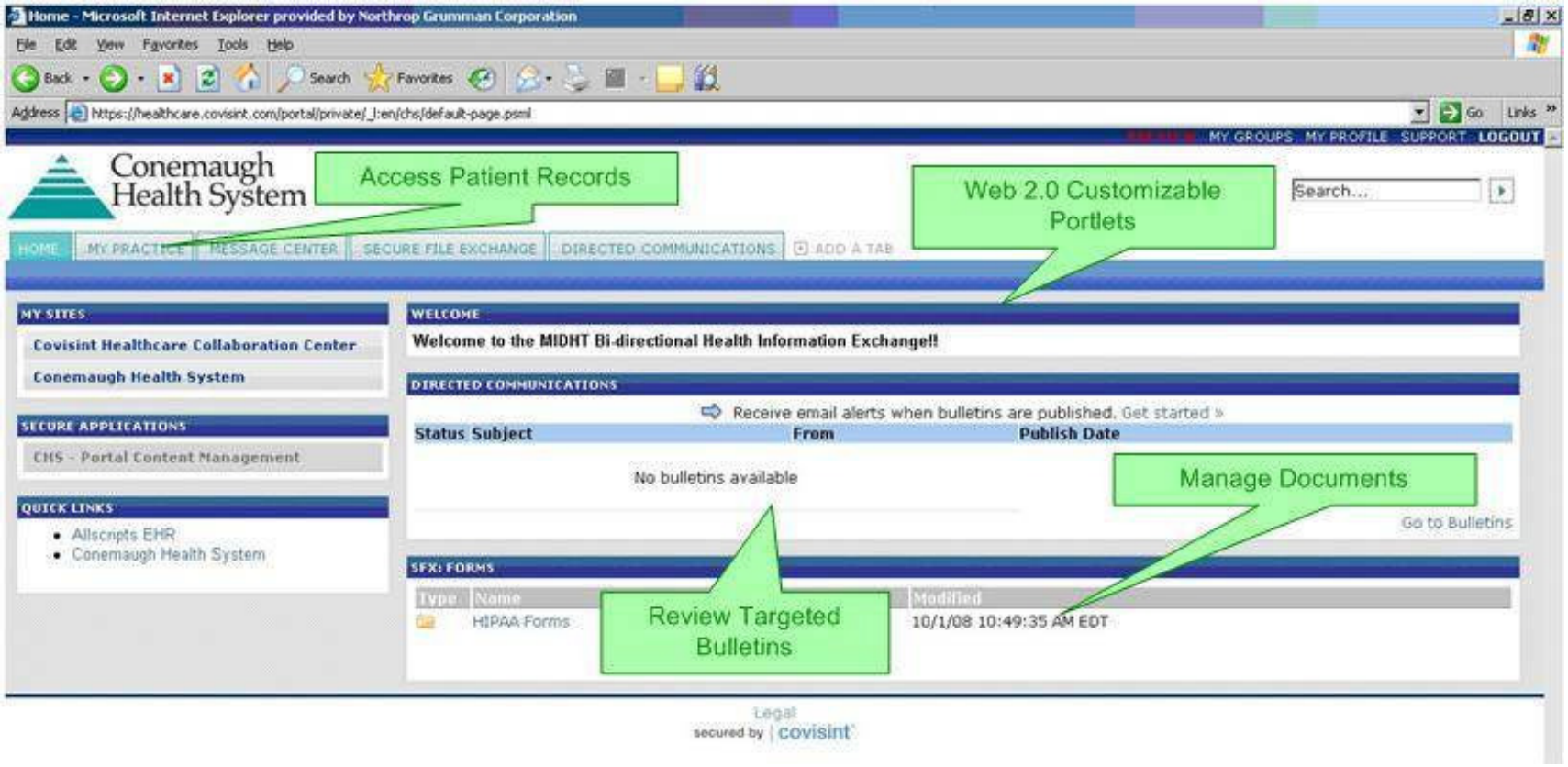


Figure 7 – "My Practice" tab

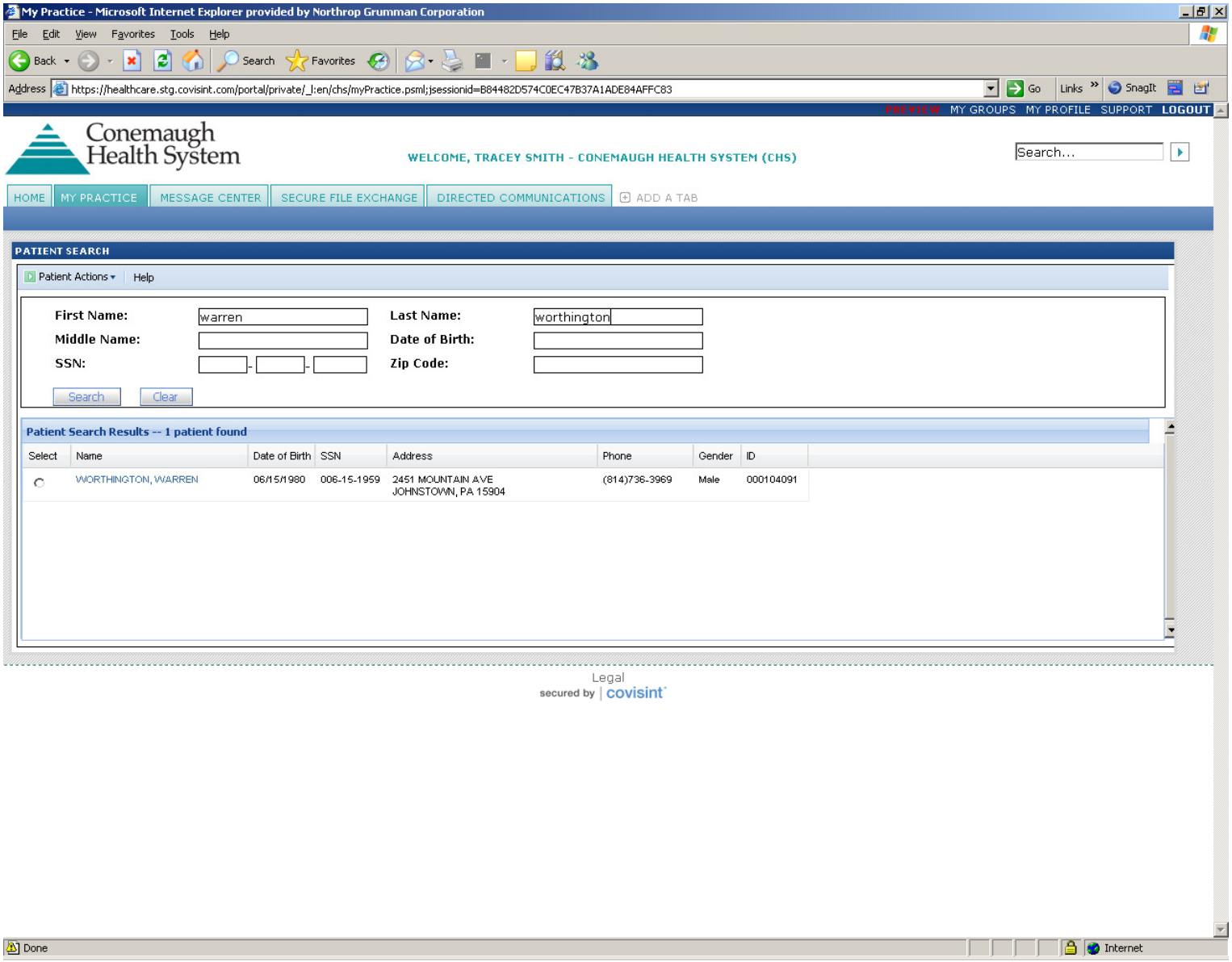


Figure 8 – "Records Portlet"

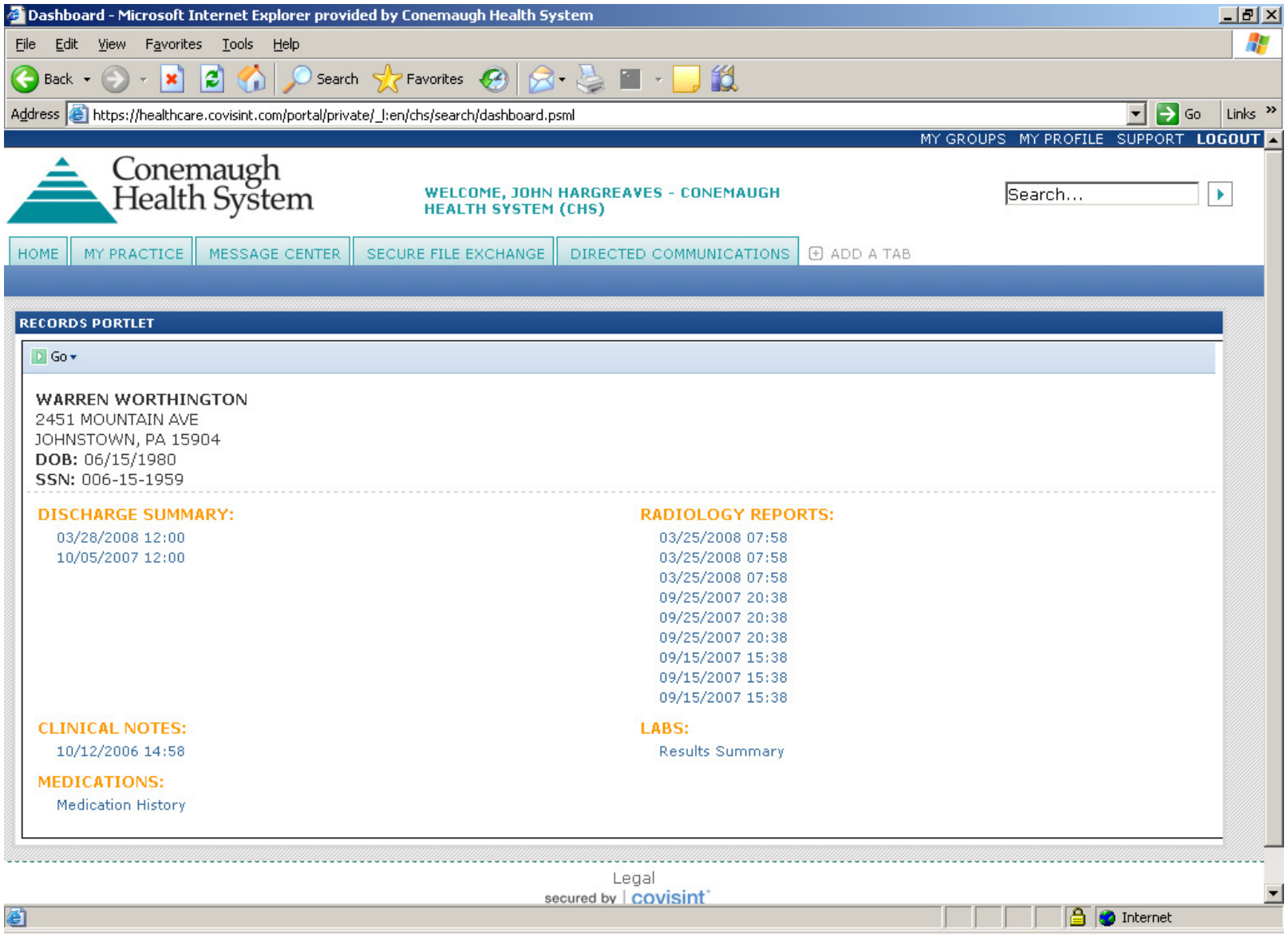


Figure 9 – Discharge Summary

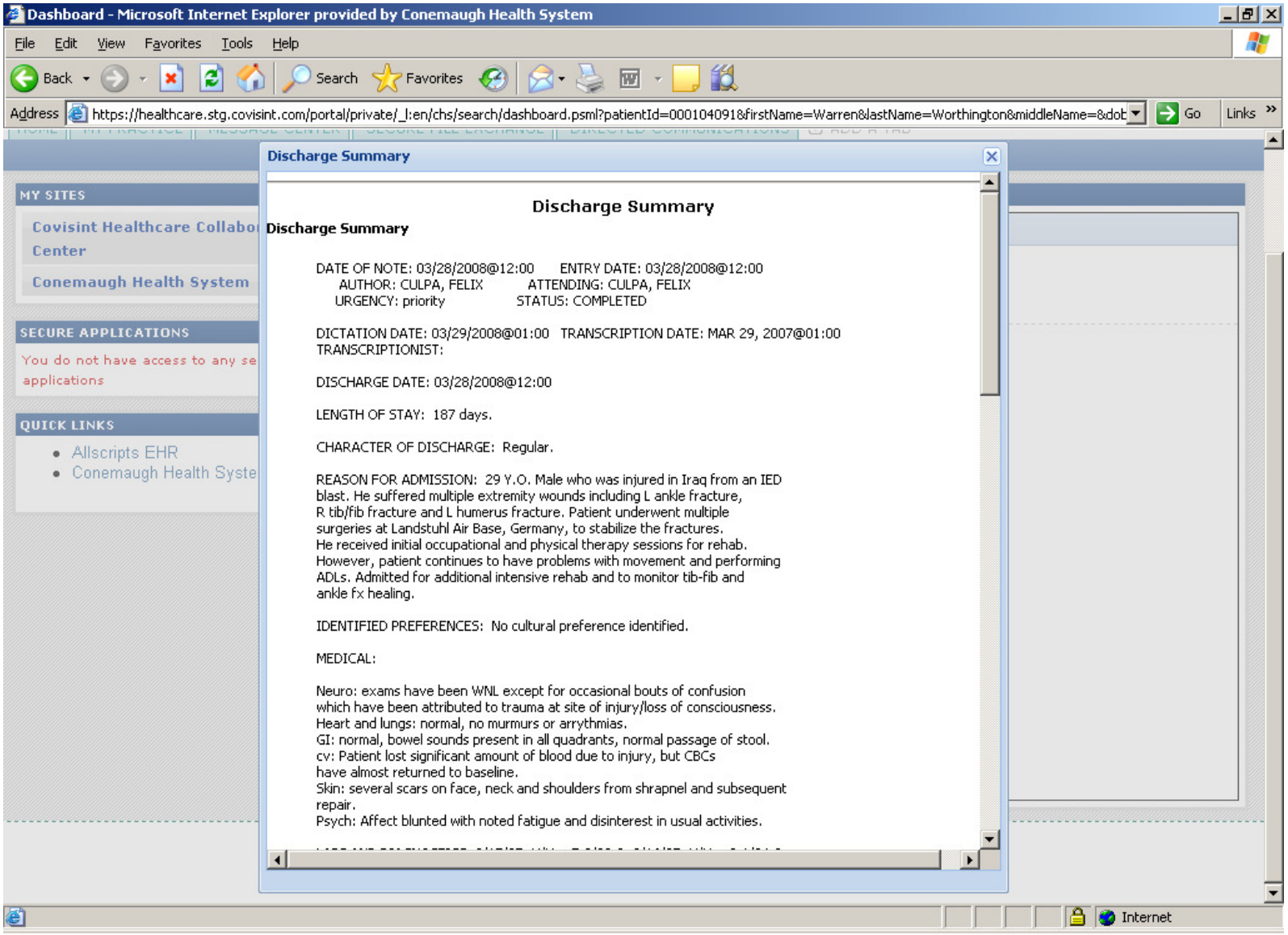


Figure 10 – Clinical Note

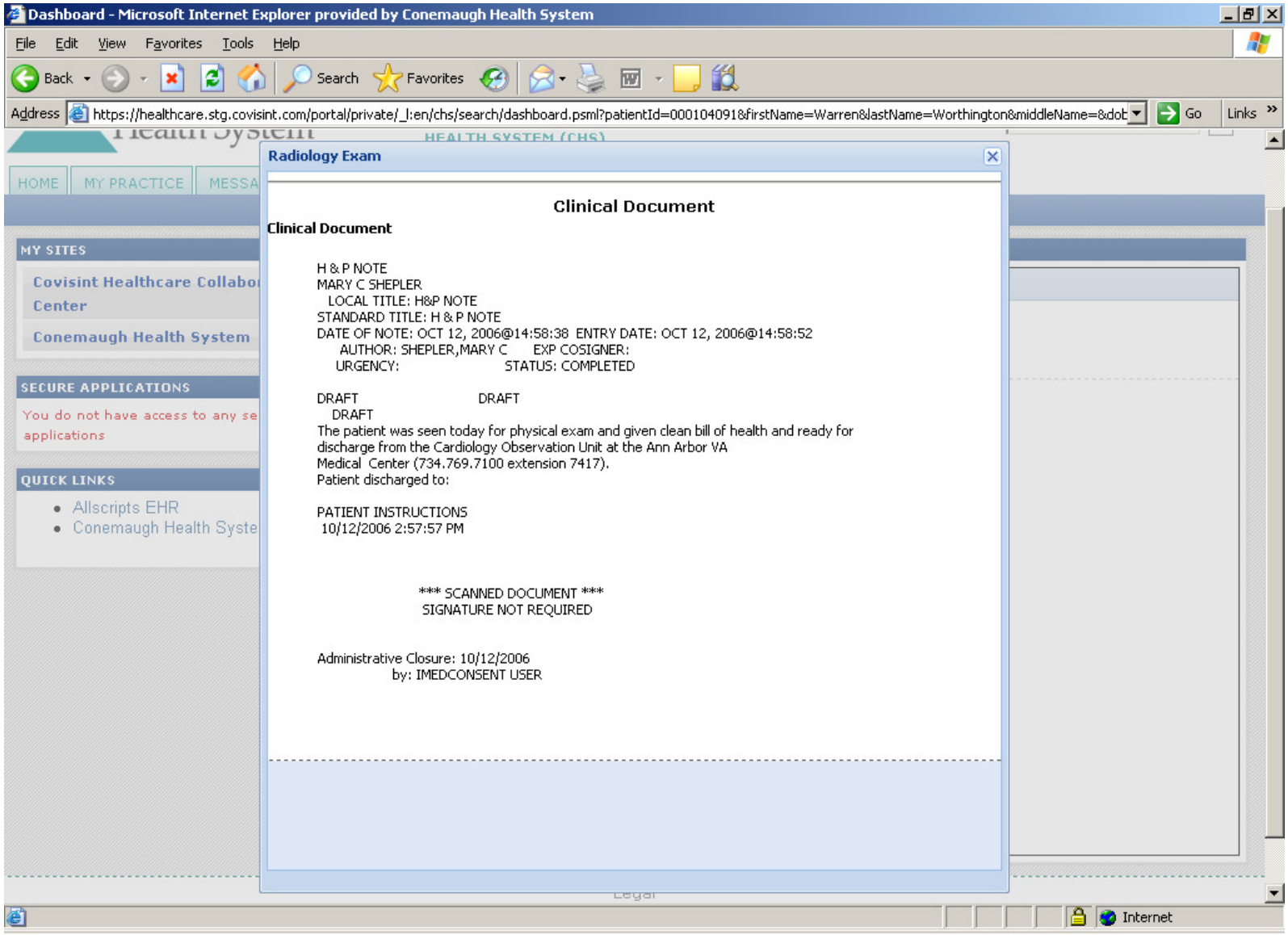


Figure 11 - Medications

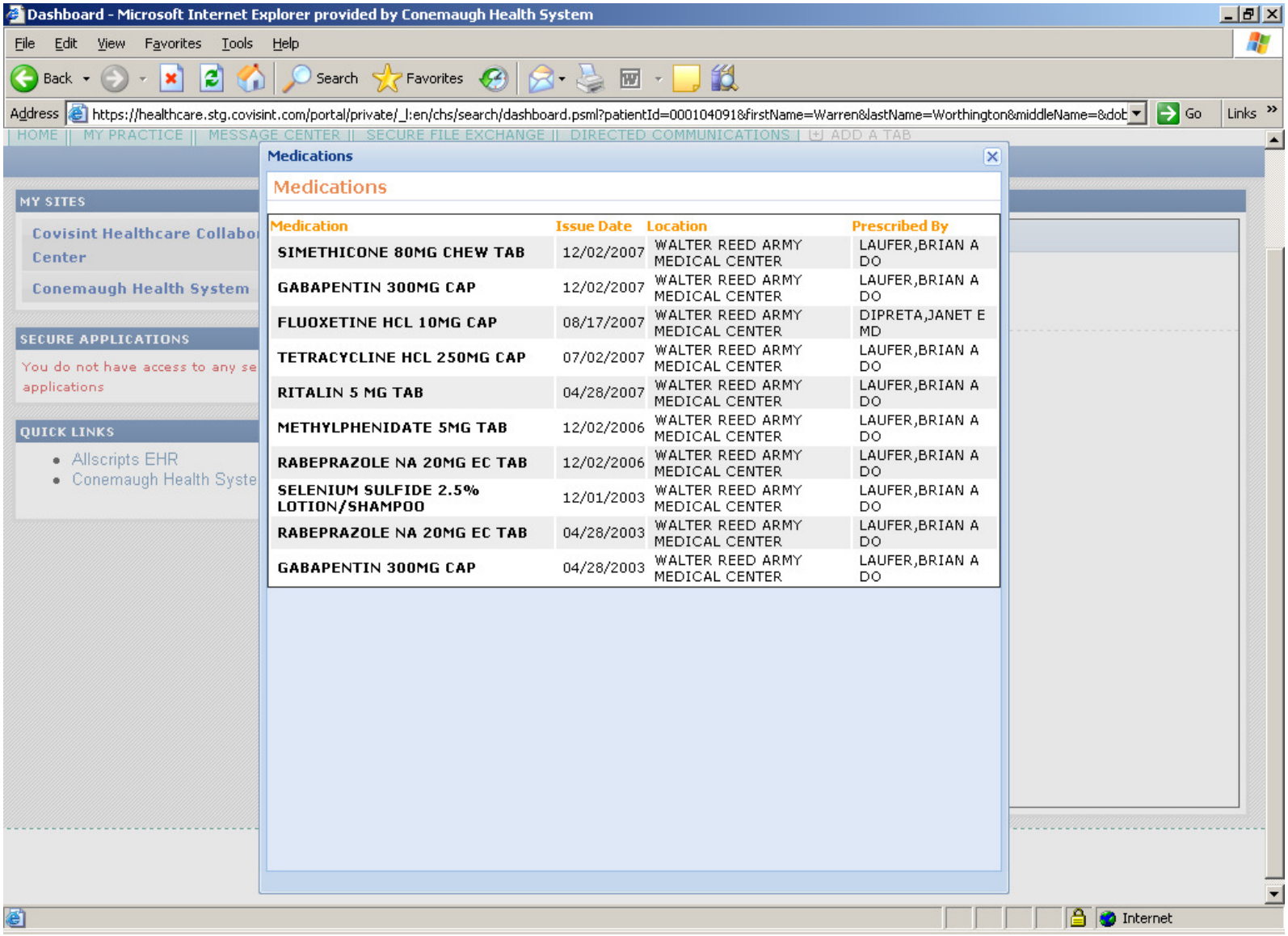


Figure 12 – Radiology Report

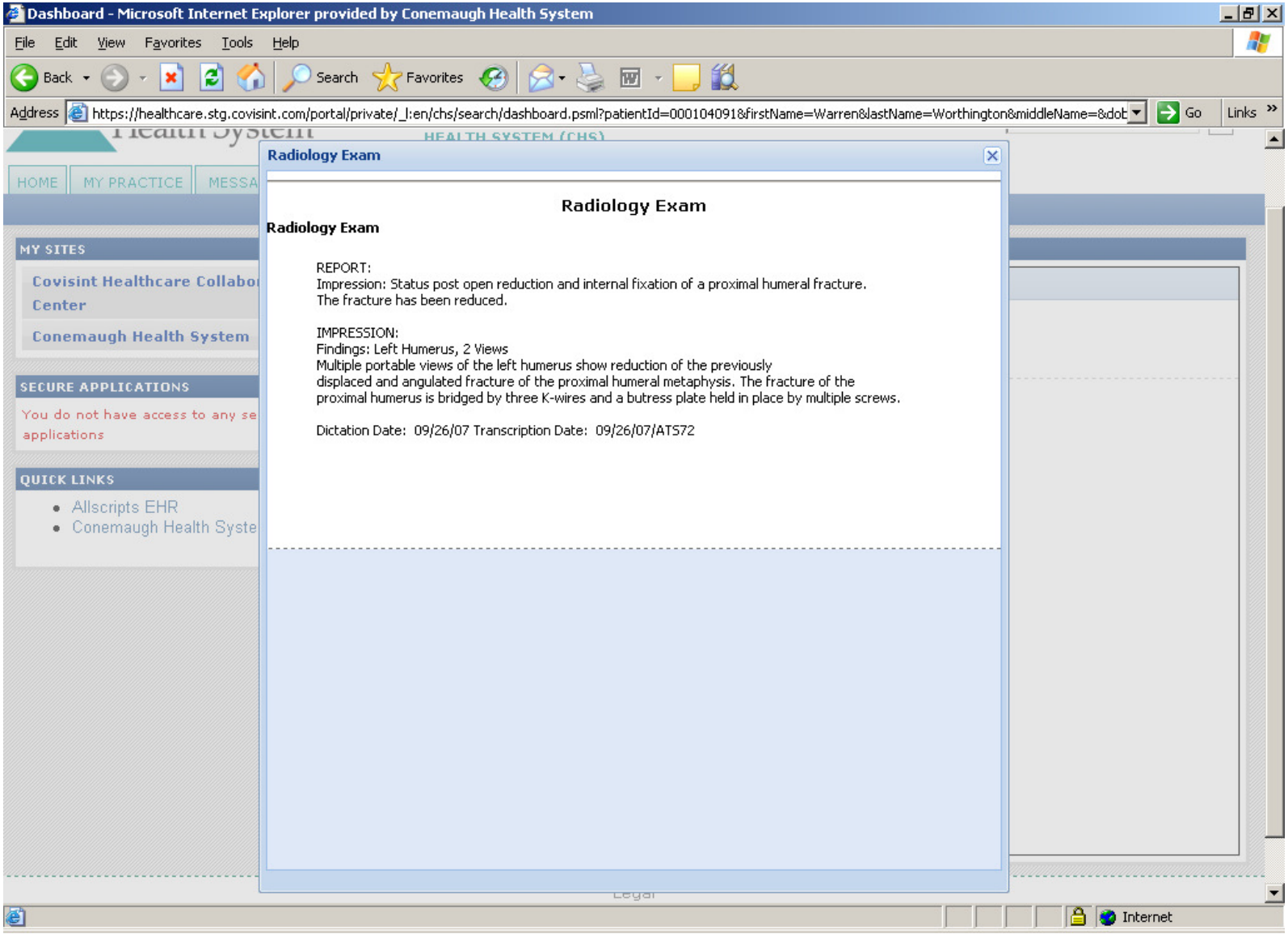
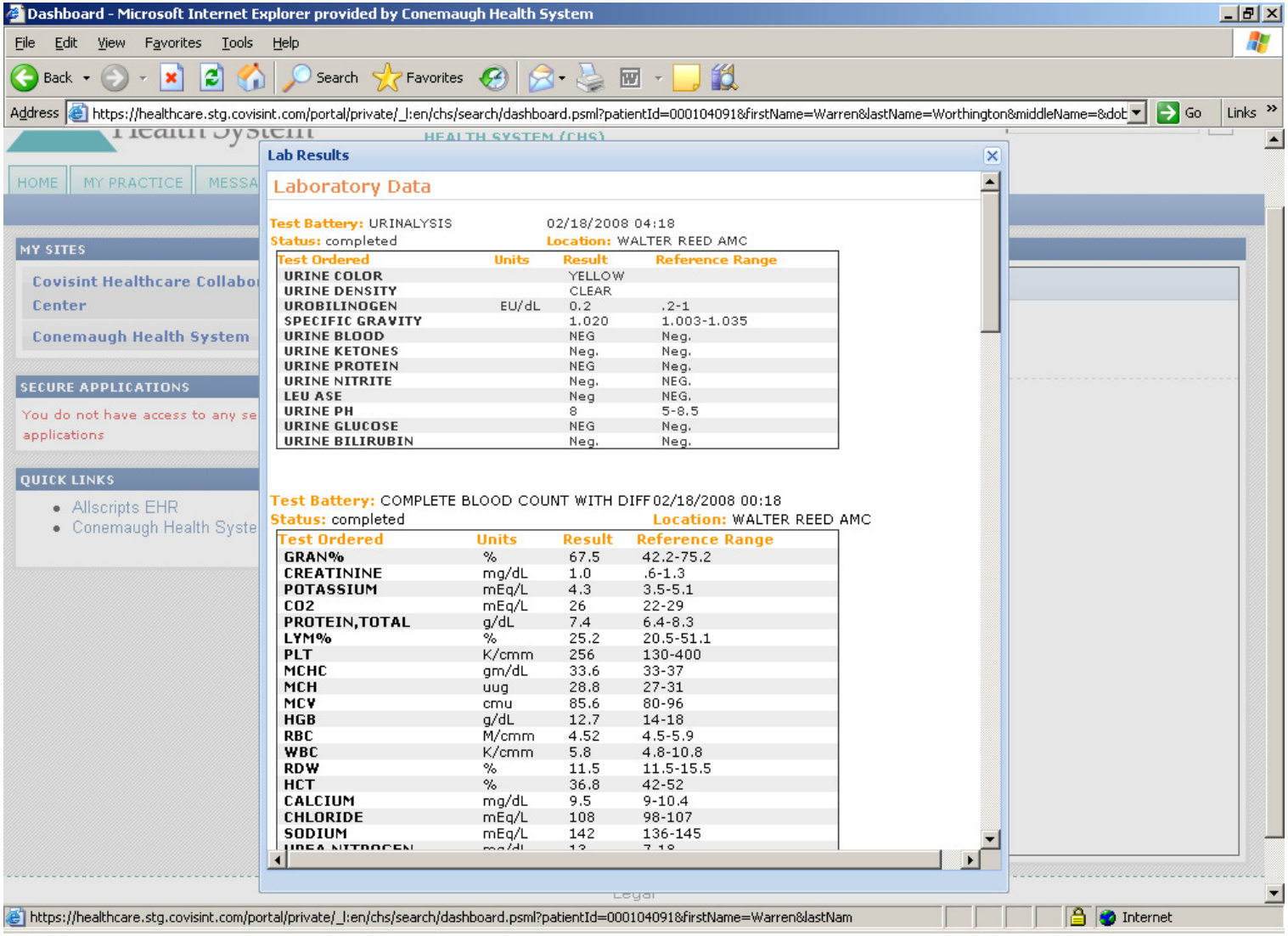


Figure 13 – Lab Results



Key Research Accomplishments

Arm 1: Longitudinal Study for the Use of Interoperable Accessible Health Information Exchange Services and Technologies in Rural Communities (Study A-14456.2)

This research study, which received MMC IRB approval on 25 June 2008 and USAMRMC IRB approval on 7 August 2008, is a descriptive, longitudinal study using a repeated measures design, to be completed over the course of five years. The goal is to identify the impacts of HIE services in a rural health care system environment. Year 1 research program will serve to establish the baseline research and data collection for the longitudinal study. In future years, as the MIDHT technical infrastructure is further developed and implemented, a technical research framework will also be developed to assist in evaluating the impact of HIE services and technologies upon the healthcare delivery system stakeholders.

MIDHT will seek to address the hesitancy of HIE adoption based on return on investment (ROI) doubts and concerns by clearly portraying *how* and *why* information exchange will improve workflow and the delivery of healthcare. Currently, providers are able to visualize the benefits, but the MIDHT project will clearly demonstrate the process of achieving these benefits. Health care providers are hesitant to invest in healthcare IT due to high start-up costs or any guarantee of a return on investment.

Research Objectives

1. Identify the baseline productivity and workflow before implementation of an electronic health record using financial reports and a Time & Motion tool.

2. Investigate the baseline attitudes, perceptions and readiness for HIE services and health information technology of CHS healthcare stakeholders, to include physicians, administrators, board members and physician support (e.g. nurse).

3. Evaluate pre-implementation practice patterns of TRICARE providers to identify current state of electronic health information exchange and potential areas for improvement.

1. Workflow Analysis - Baseline

During Year 1 of the MIDHT, the research staff conducted a baseline workflow and productivity analysis at two CHI ambulatory physician office locations prior to the implementation of the Allscripts electronic health record (EHR) technology. Physician offices included in the analysis were Portage Health Center (PHC) and NORCAM Community Health Center (NCHC). Staff at both offices were invited to participate in the study and provided with an informed consent document to review prior to their participation. Before beginning an observation with each participant, a member of the research staff reviewed the informed consent with each participant, answered questions, and reviewed their rights as a research subject. Signed consent was not obtained as to maintain anonymity of the study participants. The tables below detail the subjects' participation in the study. Each subject was typically shadowed for a four-hour continuous period. (Note: PHC is a larger office and thus more subjects were involved as stated below to create a representative sample.)

Table 1 – NORCAM Subject Participation

NORCAM

Position Description	Time per Process, (hrs:min:sec)	% of Total Time	No. of Unique Individuals observed
Clerical staff	10:19:17	37.3%	3
Physician	6:53:00	24.9%	2
Clinical personnel (RN, LPN)	6:52:28	24.9%	2
Office Manager	3:34:01	12.9%	1
Physician Assistant	0:00:00	0.0%	0
Total:>	27:38:46	100.0%	8

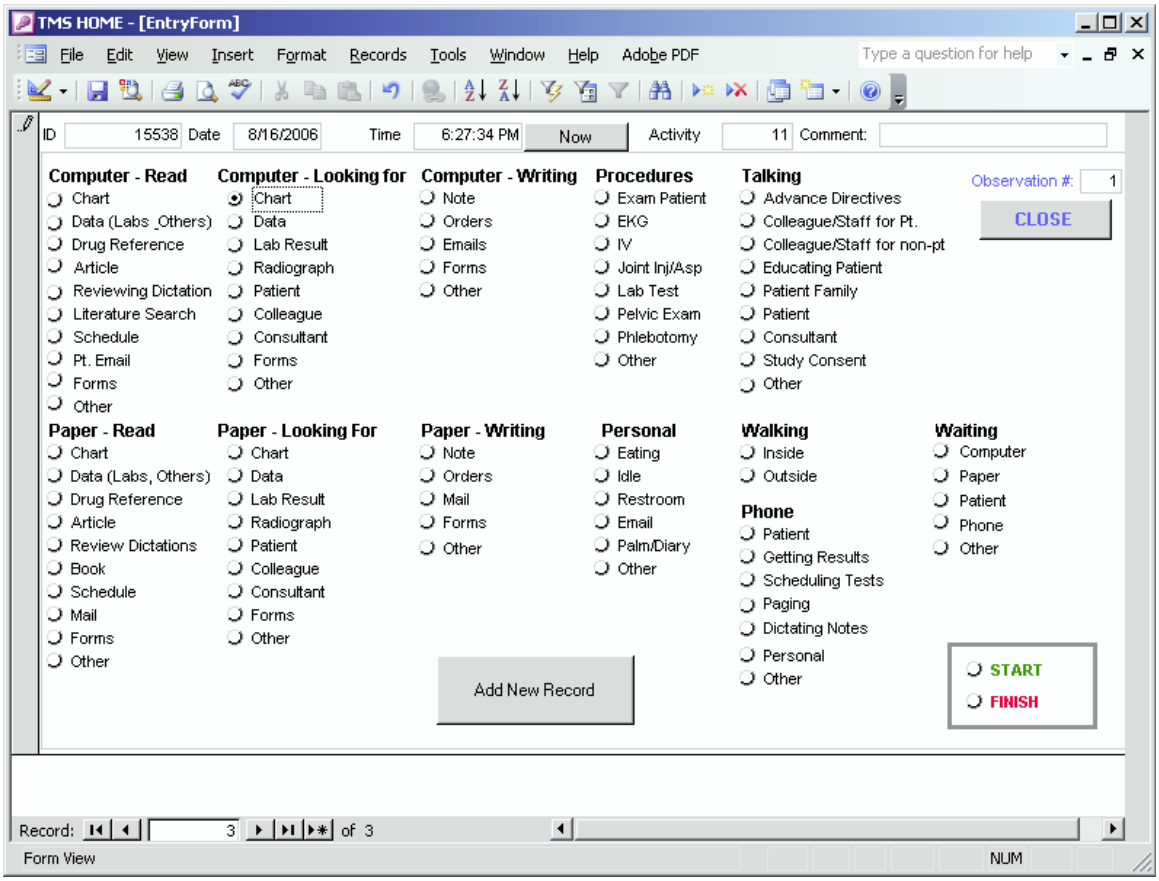
Table 2 – Portage Subject Participation

PORTAGE

Position Description	Time per Process, (hrs:min:sec)	% of Total Time	No. of Unique Individuals observed
Clerical staff	12:02:24	27.9%	3
Clinical personnel (RN, LPN)	11:55:39	27.6%	3
Physician	11:44:18	27.2%	3
Office Manager	3:49:35	8.9%	1
Physician Assistant	3:40:56	8.5%	1
Total:>	43:12:52	100.0%	11

Researchers conducted the workflow analysis using the Time & Motion Study Tool: Ambulatory Practice (TMS-AP) developed by Partners Healthcare in cooperation with the Agency for Healthcare Research and Quality (AHRQ). The aforementioned software program is Microsoft Access based and was downloaded to tablet personal computers for portability. The following is a screen shot of the data that was collected using this tool:

Figure 14 – Time & Motion tool



Process Formulation

As standard in many ambulatory physician offices, multiple processes are completed in order to effectively provide quality healthcare to patients. These processes include the activities routinely carried out in the office in a typical day that involve all aspects of patient care, from scheduling patients to receiving results for tests and procedures (refer to Appendix A). The processes listed below were established based on data collected and their relevancy to the planned EHR deployment. (Note: EHR will be implemented in both physician offices and the Time & Motion study will be performed again post implementation.)

Table 3 - Process Description

Process Description	ID Number
Clinical Notes/Transcription/Dictation	5
Medical Records Management	4
Medication Orders/Refills	1
Phone - Patient	6
Receiving Test Results	3
Revenue Cycle	9
Scheduling Patients in Office	7
Talking - Colleague/Walking Inside	8
Write Dx Orders/Scheduling Tests & Referrals	2
All Others Not Included in Analysis	0

The two physician offices being equipped with EHR have many similarities and differences. PHC (Urban), located 19 miles north of Johnstown, PA and Memorial Medical Center (MMC), currently uses an electronic system for patient scheduling and billing. Additionally, patient medical records are documented on paper charts as well as electronically via a consumer off the shelf (COTS) product. Most referrals and procedures from PHC are sent to MMC. NCHC (Rural), located 30 miles north of Johnstown, PA, currently uses the same electronic system for patient scheduling and billing. However, unlike PHC, NCHC currently only uses paper medical records and does not utilize an EHR. NCHC primarily sends patient referrals and procedures to Miners Medical Center (MiMC). Both physician offices currently have electronic access to patient data contained within the hospital-based information system (McKesson Care Portal) and perform in-house basic lab work within their respective facilities (i.e. urinalysis).

Time Results by Process

Listed below are the results from the time and motion studies, broken down into processes. The percentage of time spent per office on each process is also documented in two ways.

Table 4 – NORCAM Time Results

NORCAM

Process Description	Time per Process, (hrs:min:sec)	% of Total Time		% of *Sub*Total Time [1]	ID Number
Clinical Notes/Transcription/Dictation	4:04:19	14.5%		24.5%	5
Medical Records Management	3:57:37	14.1%		23.9%	4
Talking - Colleague/Walking Inside	2:16:24	8.1%		13.7%	8
Phone - Patient	1:40:54	6.0%		10.1%	6
Scheduling Patients in Office	1:22:56	4.9%		8.3%	7
Revenue Cycle	1:02:28	3.7%		6.3%	9
Write Dx Orders/Scheduling Tests & Referrals	0:56:17	3.3%		5.6%	2
Medication Orders/Refills	0:43:26	2.6%		4.4%	1
Receiving Test Results	0:31:51	1.9%		3.2%	3
***Sub*Total:>**	16:36:12	59.2%			
Remaining Activity IDs excluded from Processes and therefore, Not Included in Analysis	11:25:48	40.8%			0
Totals:>	28:02:00	100.0%		100.0%	
NOTE 1: Based only on processes 1 through 9, inclusive.					

Table 5 – Portage Time Results

PORTAGE

Process Description	Time per Process, (hrs:min:sec)	% of Total Time		% of *Sub*Total Time [1]	ID Number
Medical Records Management	7:08:39	16.3%		29.3%	4
Clinical Notes/Transcription/Dictation	3:53:26	8.9%		15.9%	5
Talking - Colleague/Walking Inside	3:48:33	8.7%		15.6%	8
Phone - Patient	3:39:08	8.3%		15.0%	6
Medication Orders/Refills	1:42:57	3.9%		7.0%	1
Write Dx Orders/Scheduling Tests & Referrals	1:40:11	3.8%		6.8%	2
Scheduling Patients in Office	1:23:58	3.2%		5.7%	7
Receiving Test Results	0:39:42	1.5%		2.7%	3
Revenue Cycle	0:28:39	1.1%		2.0%	9
***Sub*Total:>**	24:25:13	55.8%			
Remaining Activity IDs excluded from Processes and therefore, Not Included in Analysis	19:21:00	44.2%			0
Totals:>	43:46:13	100.0%		100.0%	
NOTE 1: Based only on processes 1 through 9, inclusive.					

Process Descriptions

Clinical Notes/ Transcription/ Dictation

The process of dictation and writing clinical notes varied within offices and among physicians. Some physicians relied more on documenting in clinical notes while others dictated in more traditional methods, including dictaphone recorders. Activities included in this process include: writing notes and transcribing on the computer, writing notes and forms on paper or looking for paper forms, walking throughout the building (in one case when trying to locate a missing dictation tape), and dictating notes on the phone.

Medical Records Management

The process of managing thousands of patient medical records, both paper and electronic charts, is a continuous daily effort and very time consuming for both of these physician offices. Activities included in this process are looking for an electronic chart (PHC only), looking for a paper chart, looking for patient related forms (i.e. medication list), printing patient data for inclusion in chart, sorting through patient charts, copying, scanning patient data (PHC only), shredding protected health information, and sending patient medical records for referral appointments via fax and postal mail.

Medication (Rx) Orders/Refills

The process of ordering and refilling prescriptions is a common activity within all physician offices and especially important in terms of patient safety. Activities included in this process are consulting drug references (paper and computer), writing medication orders/refills on paper (NCHC only) and the computer (PHC only), printing orders (PHC only), provider signatures, faxing and calling orders to a pharmacy, hand delivery of orders to patients and completing a daily Rx sent log. Additionally, phone conversations with patients regarding Rx refills were also included. It is important to note that neither physician office was equipped with e-prescribing functionality, which leads to an interesting time analysis post-EHR implementation.

Phone- Patient

All physician offices spend a considerable amount of time on the telephone with patients, whether for scheduling, prescription refills, questions for the physician, or a variety of other reasons. The implementation of EHR may help to decrease this time, especially as it relates to prescription refills. Activities included in this process include: time spent on the phone with patients and writing notes or other documents.

Receiving & Reviewing Test Results

The process of receiving and reviewing patient test results is critical to providing quality healthcare. Activities included in this process are looking for and reading test results on the computer via McKesson Care Portal (i.e. lab/radiology), looking for and reading test results on paper, waiting for test results, and time spent on the phone getting results from outside facilities.

Revenue Cycle

Revenue cycle management is an important aspect of all physician offices, no matter how large or small or technologically adapted. Examples that office staff must complete include verification of insurance coverage, collection of co-pays, and completion of billing paperwork. Activities included in this process include: looking for patient information on computer, writing notes on computers, reading books, forms, and other documents on paper, writing forms and other documents on paper, talking to colleagues or staff for patients, talking to patients on phone or in person, and talking to others on the phone.

Scheduling Patients –Office Visit

Another fairly common routine in physicians' offices is scheduling patients for appointments, follow-up procedures, diagnostic testing, etc. Activities involved in this process include: reading schedules on the computer, looking for data or patients on the computer, writing notes or forms on the computer, reading a paper schedule, looking for patients' information on paper, writing information on paper, talking with the patient in-person or on the phone, and talking on the phone with other persons or facilities.

Talking- Colleague/ Walking Inside

In the current office structure, there is a considerable amount of time spent walking throughout the office to locate physicians or staff to relay messages and discuss patient care. This process includes the following activities: writing on the computer, reading data on paper, writing notes and other information on paper, talking to staff or colleagues about patients, walking inside the office space, and telephone calls to persons other than the patient (i.e. other physicians/staff).

Write Dx Orders/Scheduling Tests & Referrals

This two-fold process of writing Dx orders and scheduling tests/referrals is a critical activity within these two physician offices in terms of the continuum of care and communicating with stakeholders outside of the office. Activities included in this process are writing Dx orders on the computer (i.e. MRI, CAT scan, x-ray), printing orders, writing Dx orders on paper, faxing orders to respective facilities, provider signatures on orders, scheduling outside tests via phone and scheduling referrals via phone with outside facilities.

All Others Not Included in Analysis

This category includes activities that are not appropriate for analysis when considering the implementation of an electronic health record. For example, personal time (idle, eating, restroom, talking) is not included in the analysis. Additionally, standard patient exam procedures have also been removed from the analysis because they should not be affected by the infusion of health information technology.

Time Results by Provider Type & Process Number

Note: Colors do not represent the same process number. Percentage calculations do not include Process Number 0.

Figure 15 – Portage/Clerical

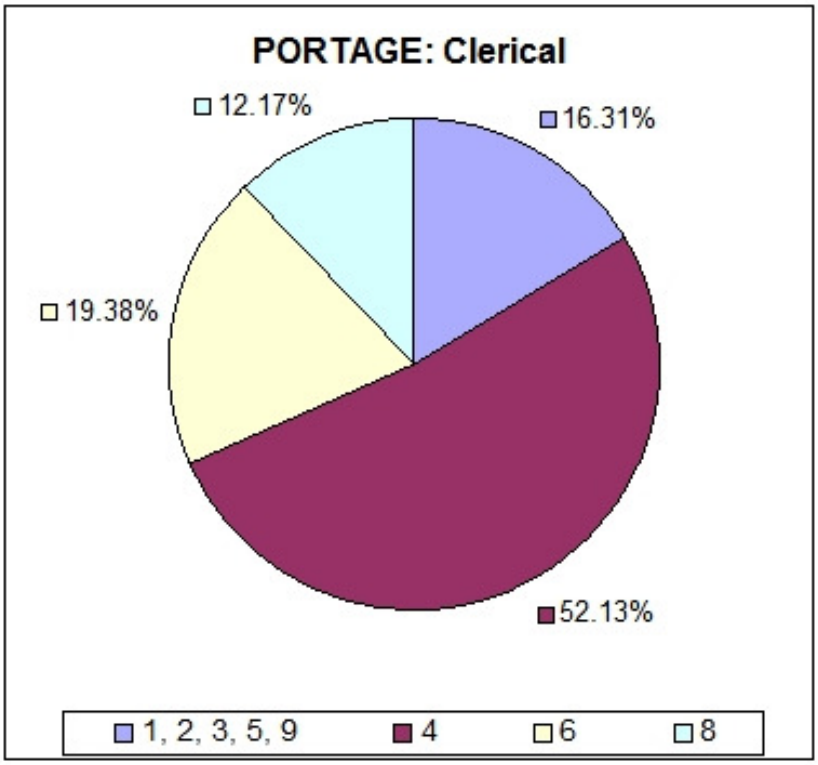
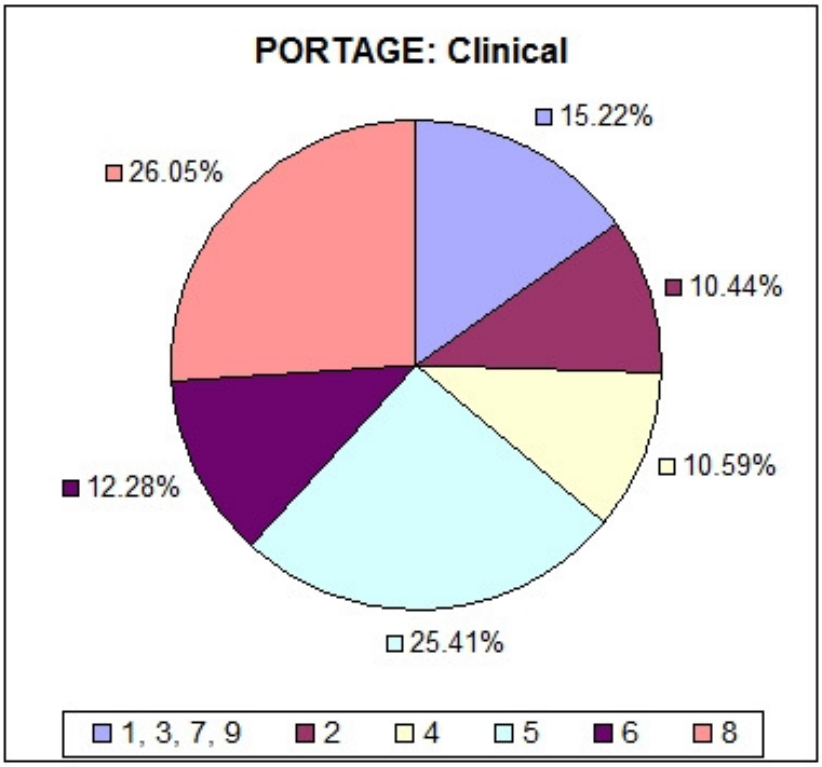


Figure 16 – Portage/Clinical



Note: Colors do not represent the same process number. Percentage calculations do not include Process Number 0.

Figure 17 – Portage/Office Manager

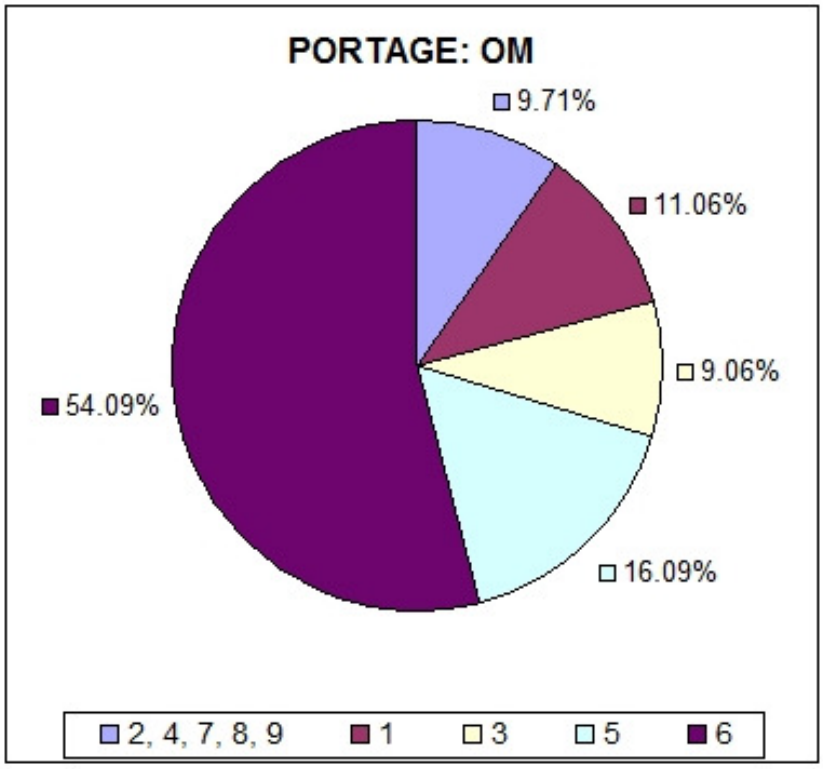
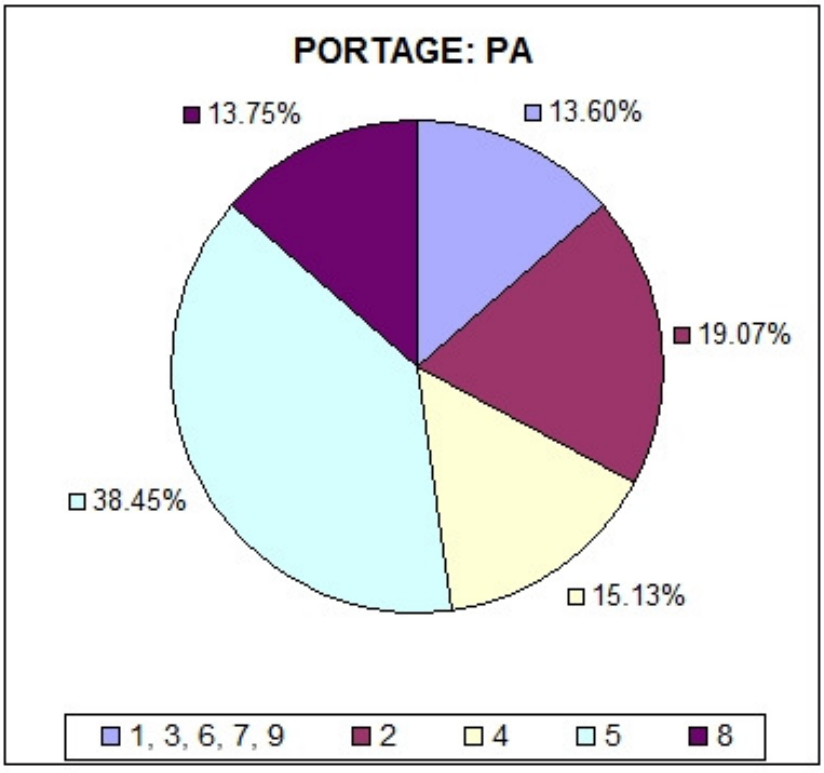


Figure 18 – Portage/Physician Assistant



Note: Colors do not represent the same process number. Percentage calculations do not include Process Number 0.

Figure 19 – Portage/Physician

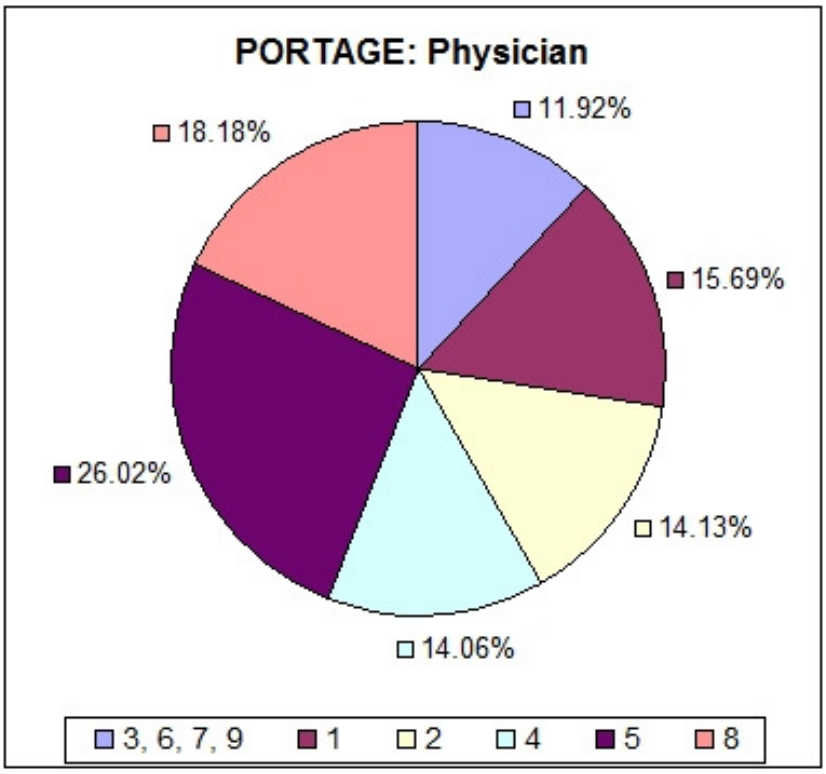
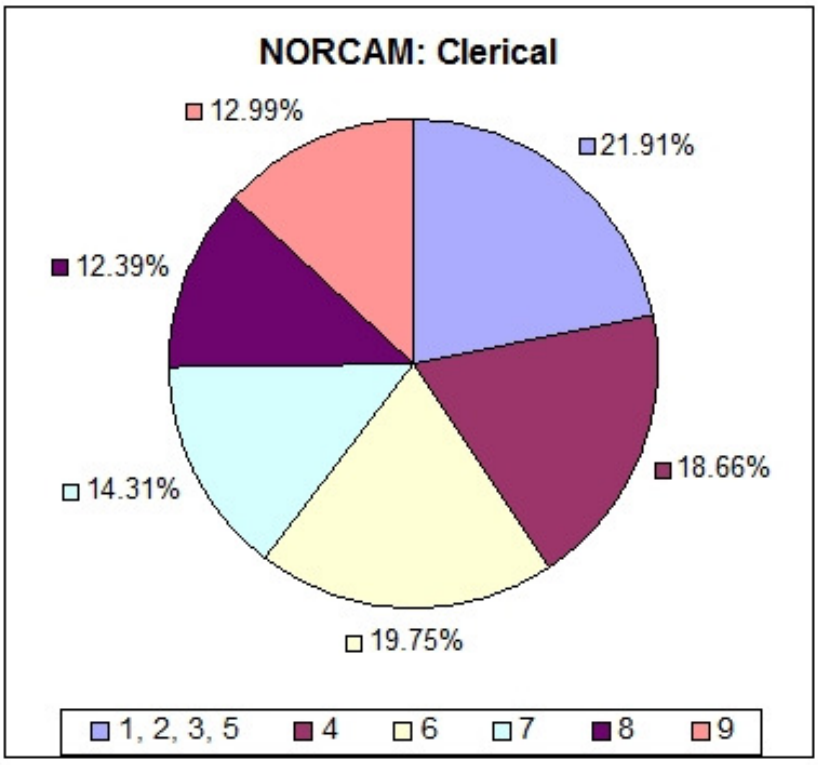


Figure 20 – NORCAM/Clerical



Note: Colors do not represent the same process number. Percentage calculations do not include Process Number 0.

Figure 21 – NORCAM/Clinical

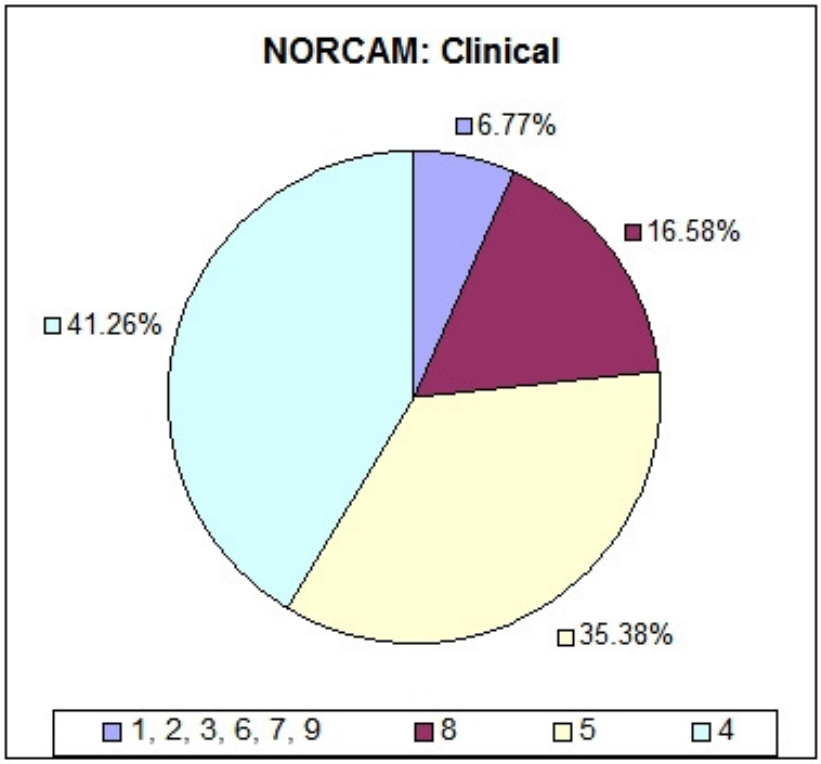
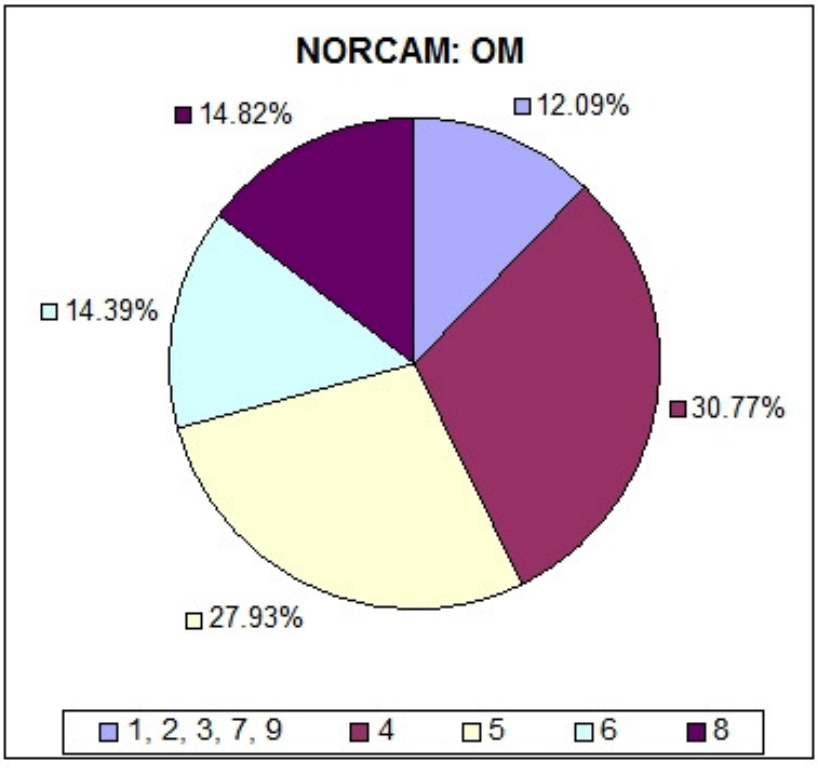
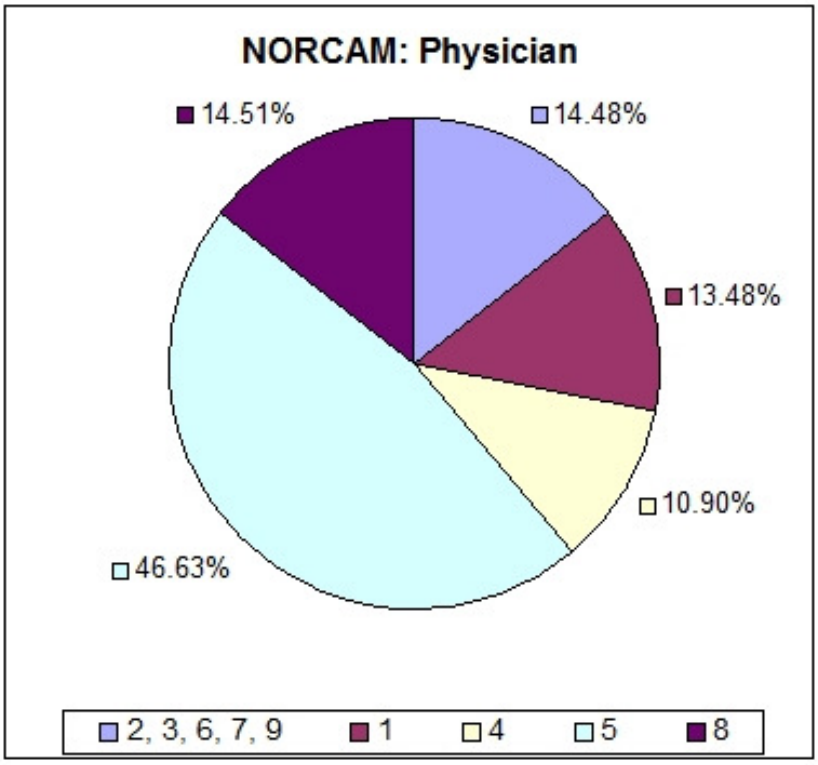


Figure 22 – NORCAM/Office Manager



Note: Colors do not represent the same process number. Percentage calculations do not include Process Number 0.

Figure 23 – NORCAM/Physician



1. Productivity Analysis - Baseline

Retrospective administrative data/reports for calendar year 2007 were utilized to collect Relative Value Units (RVUs), billing charges and number of hours worked for NORCAM Community Health Center and Portage Health Center. Additionally, data from two other physician offices not implementing an EHR (Highlands Family Practice and Ebandjieff Community Health Center) were collected and will serve as control sites.

A Resource Based Relative Value Scale (RBRVS) was implemented by Medicare in 1992 as a new methodology in determining the fees for the Medicare Physician Fee Schedule. RBRVS is broken into the following 4 costs, which are defined as RVUs:

- Work (time and effort)
- Facility Practice Expense (equipment, supplies, rent) for typical codes performed in hospitals
- Non-Facility Practice Expenses (equipment, supplies, rent) for typical codes performed in a physician office, home visit, etc…
- Malpractice expense (increased risk by specialty)

The total of the above 4 costs equals the Total RVUs for the procedure performed. The more costly, more complex the procedure the higher the RVUs compared to a less costly, less complex procedure. Medicare historically has reviewed and adjusted the RVUs every five years.

The number of hours worked and encounters were also collected for control purposes.

See below for a table representing the data that was collected pre-EHR implementation:

Table 6 – Productivity Analysis

Chg Billing Desc. Area	Chg Provider Name	Charges	Units	RBRVS work RVU	Malpractice RVU	Non Facility Prac Exp RVU	Facility Prac Exp RVU
Practice Name	Provider A						
	Provider B						
	Provider C						
	Provider D						
	Over Pay						
	Walk Ins						

Encounters	"Office" Hours Worked	Encounters/Hour

2. Baseline Attitudes, Perceptions and Readiness for Health Information Technology (HIT)

Paper and electronic surveys were distributed to a mix of stakeholders within the Conemaugh Health System as defined in the protocol to collect attitudes, perceptions and readiness regarding health information technology. Please see the following table for a summary of anonymous responses by physicians on the CHS medical staff:

Table 7 – Physician Survey Participants

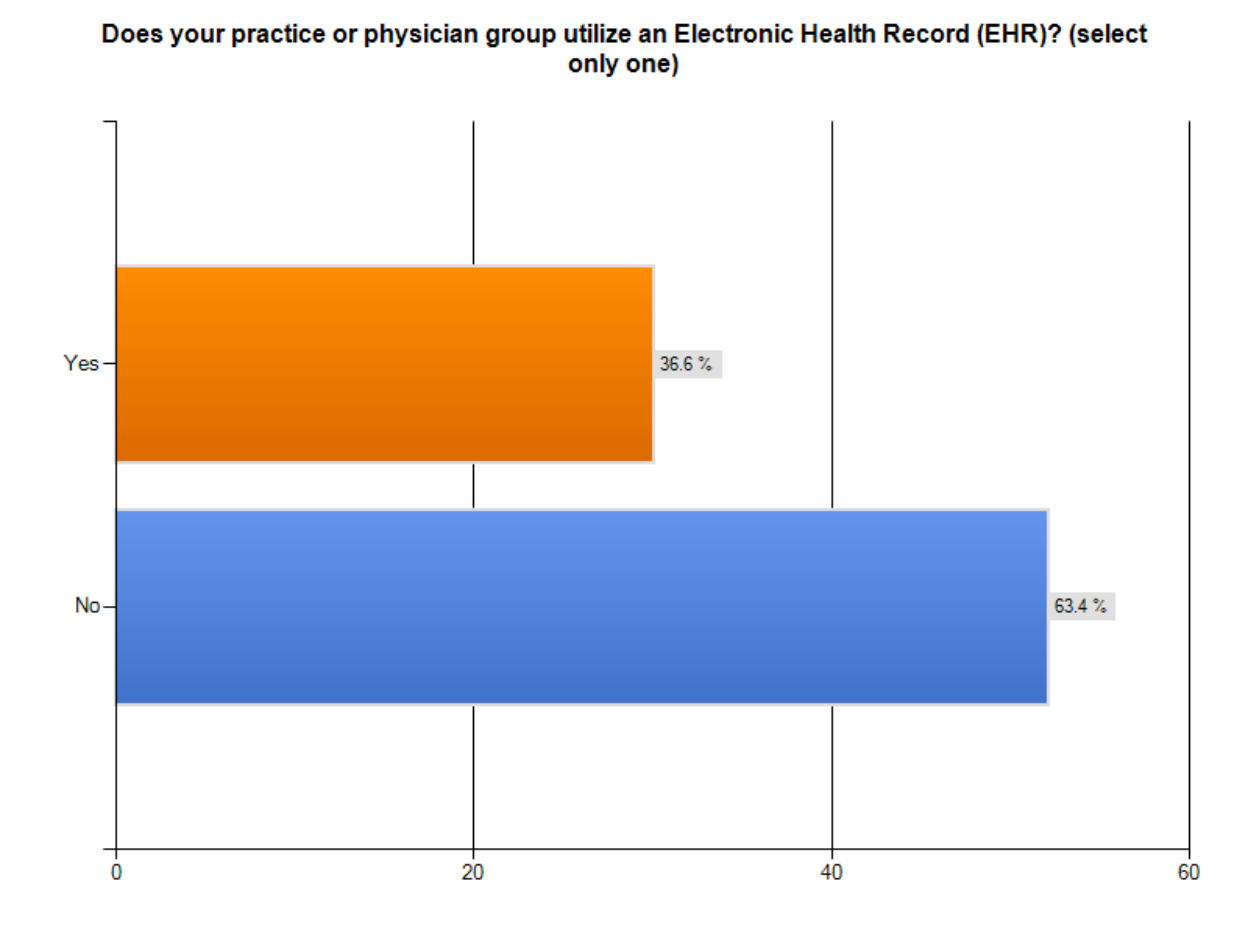
	HIT Surveys		Average Response Rate
	Distributed	Returned	
Physicians:	340	82	24%
Hospital - Employed (CHI)		41	
Independent		41	
Primary Care		38	
Specialist		44	

Physician Attitudes Towards Electronic Health Records and Health Information Exchange (HIE)

Eighty-two (82) physicians provided informed consent by completing the anonymous survey, with a proportionate share of hospital-employed and independent physicians. Additionally, slightly more specialists responded to the survey than primary care physicians. The goal of the survey was to collect information from physicians on the CHS medical staff regarding their current use of health information technology (e.g. EHRs, HIE) and determine attitudes, perception, and readiness thereof.

Results from Question 2 as depicted below were surprising as 30 physicians or 37% are currently utilizing an Electronic Health Record (EHR). Researchers believe a nonresponse bias occurred, due to the low response rate and physicians who did not respond are likely to have lower EHR adoption rates. Centers for Disease Control and Prevention defines non response bias as "Potential skewing because of non-response. The answers from sampling units that do produce information may differ on items of interest from the answers from the sampling units that do not reply."[1]

Figure 24 - EHR Adoption



Researchers compared this data to a national EHR adoption study of 2,758 physicians published in the *New England Journal of Medicine* (NEJM) in June 2008. The following Chi-Square test confirms that the two (2) sets of results are independent of one another, which supports the non response bias reasoning. Researchers believe that the percentage of EHR users on the CHS medical staff are more aligned with national data, approximately 17%.[2]

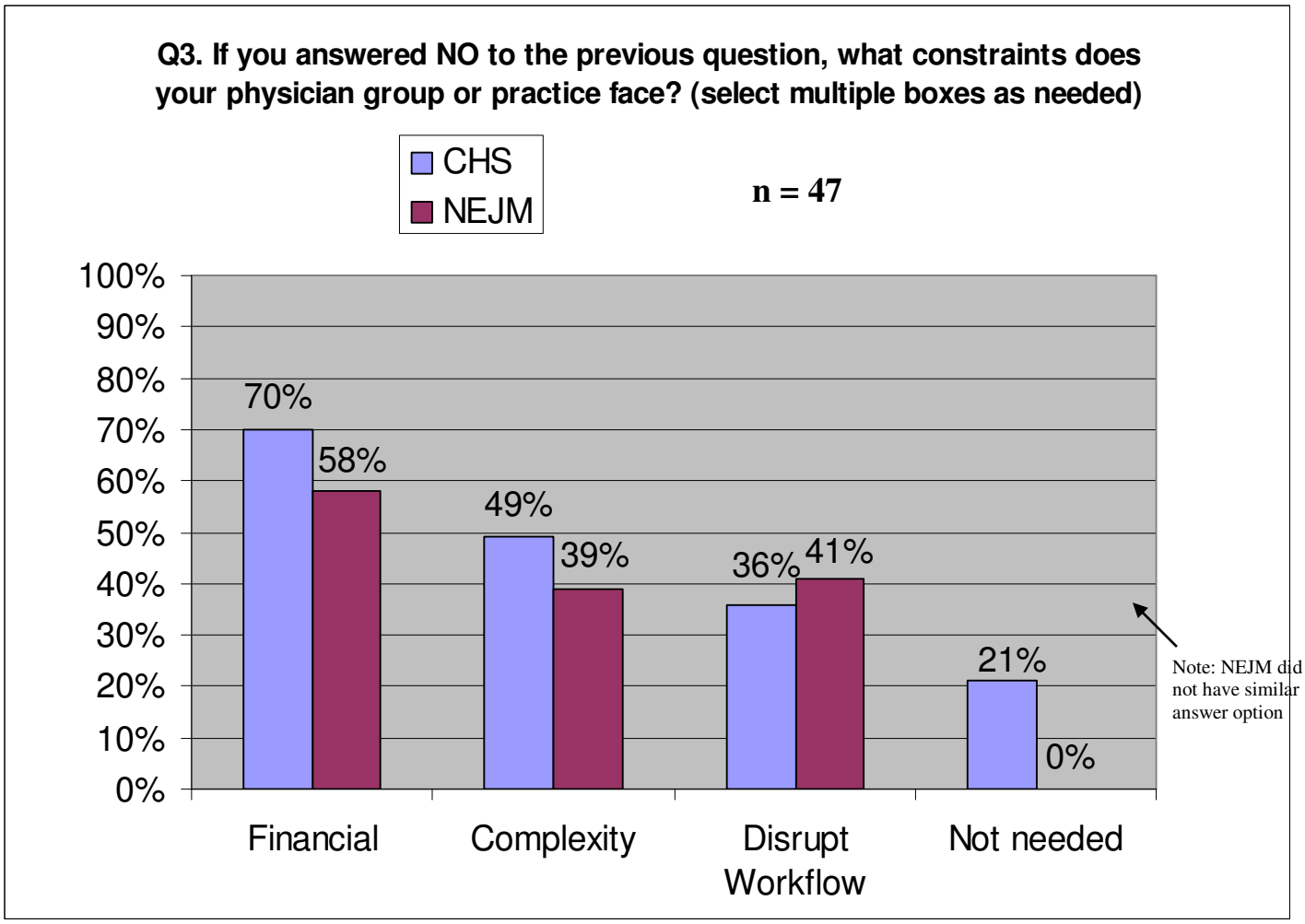
Table 9 – Chi-Square Test

			CHS	NEJM	
Q2. Does your practice or physician group utilize an Electronic Health Record (EHR)? (select only one)	0 = "No"	Count	52	2289	2341
		Exp. Cnt	43	1887	1930
	1 = "Yes"	Count	30	469	499
		Exp. Cnt	5	82	88
	Total		82	2758	2840
			48	1969	2017

Chi-Sq =	0.0000000000000000
indicates independence	
alpha	0.05
Df	1

Question 3 provided insight into the barriers and constraints physicians face regarding EHR adoption. Not surprisingly, financial was the largest constraint (70%), followed by complexity (48%), disrupt workflow (36%), and not needed (21%). These results are similar to national survey results published in the *New England Journal of Medicine* as the chart depicts below. Researchers compared the CHS data to similar answer options contained within the NEJM study in order to conduct a graphical analysis. It is quite clear that many physicians have a perception or direct experience that they cannot afford certified electronic health records and this will be a major barrier in the push for the government's 90% adoption goal by 2014. Government, providers and EHR vendors must work together to find an affordable solution to transform the healthcare industry into the digital age.

Figure 25 – EHR Adoption Barriers



Health information exchange (HIE) refers to the process of reliable and interoperable electronic health-related information sharing conducted in a manner that protects the confidentiality, privacy, and security of the information. Essential to this process is the capability to employ nationally recognized standards as they are established incrementally, further enabling interoperability, security and confidentiality of the information as well as authorization of those who access the information.

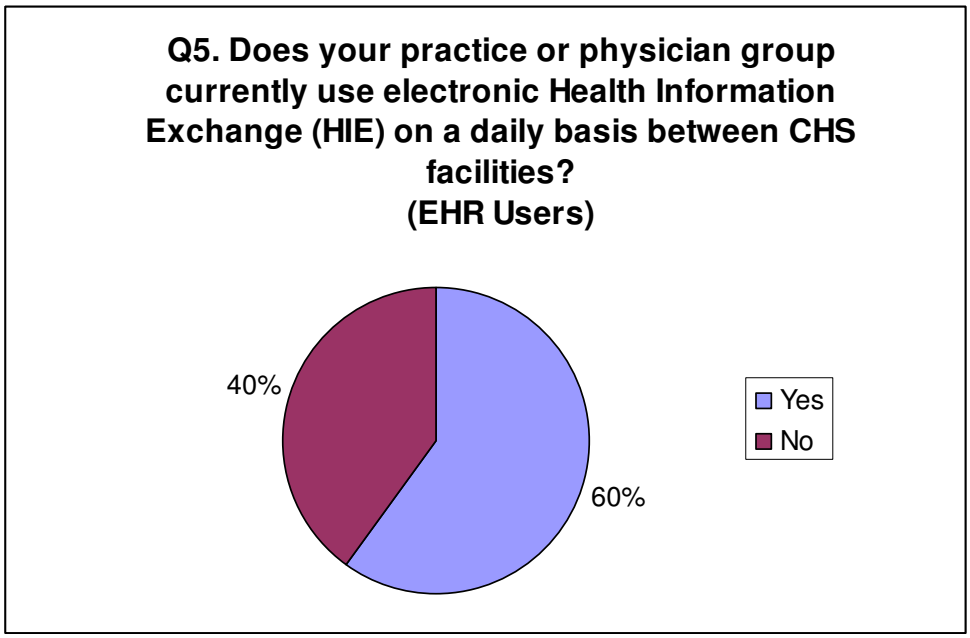
Networks that are self-contained, such as those linking a hospital to affiliated practices, to other hospitals in an organization or to labs, can exist without having to employ nationally recognized standards. In the case of networks that make the exchange of information possible solely through proprietary means, the process is not considered HIE under the definition below. HIE at minimum must be technologically ready to conform to nationally recognized standards as they are available.

HIE supports the sharing of health-related information to facilitate coordinated care through the utilization of EHRs. HIE also provides key information to individuals to promote health and wellness through population of PHRs, and can be used to support research, public health, emergency response, and quality improvement. In addition, HIE enables the sharing of health-related information among health care organizations and with individuals on a local, regional, and national basis. This interplay of electronic records and health information exchange is an important component in establishing the basics of an infrastructure that will become the Nationwide Health Information Network (NHIN).[3]

CarePortal powered by McKesson provides physicians and other care givers of the Conemaugh Health System with secure, real-time access to hospital-based patient specific information at their convenience, whether at the hospital, office, home or even out of town. With a single sign-on care providers can access laboratory results, PACS images as well as radiology reports, various transcribed reports such as consult, post-operative, H&Ps, discharge summaries, and Emergency Room reports. Medication records from home as well as inpatient medications are readily available as well as allergy information. CarePortal also allows access to previous charts with its medical records view. Physicians also sign and edit their transcribed documents on-line. Clinical documentation from nursing and other ancillary departments such as dietary, physical, speech, occupational therapy, respiratory, and social services is also available. Users also have access to an extensive physician-focused resource center with the latest in clinical research and findings from MD Consult. This technology currently serves as HIE within CHS and has been included for clarification.

The results to question 5 are depicted below in pie charts and are reported by two groups (EHR Users & Non-EHR Users). Despite all physicians on the CHS medical staff having access to CarePortal as described earlier, only 52% of respondents are currently using electronic HIE on a daily basis. The pie charts conclude that EHR users were surprisingly only 12% more likely to use HIE on a daily basis. However, researchers do believe there may have been some confusion among physicians as CarePortal was not referenced as an example in the respective survey question. The results do suggest that readiness for health information exchange is inconsistent and varies by physician.

Figure 26 – HIE Adoption



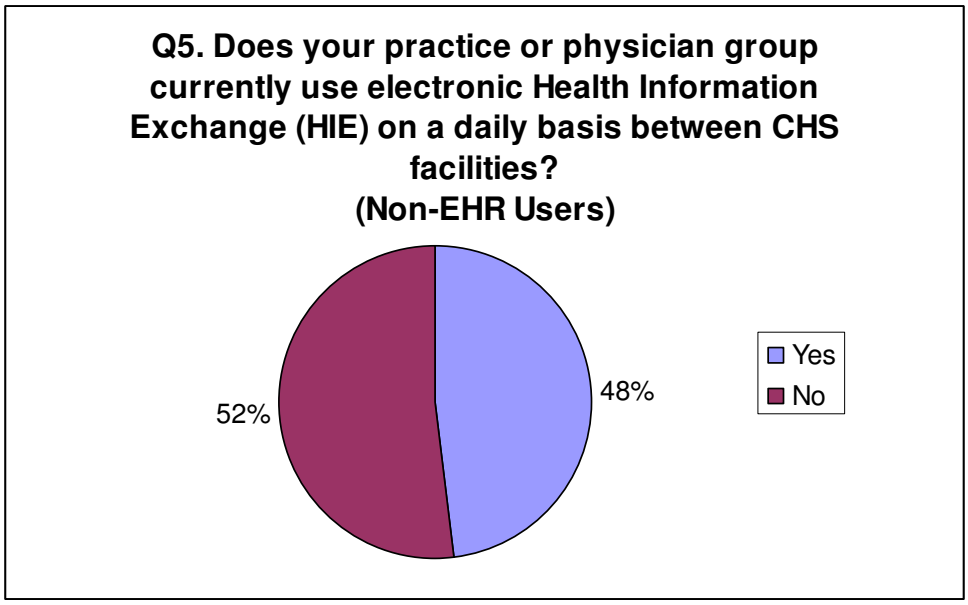
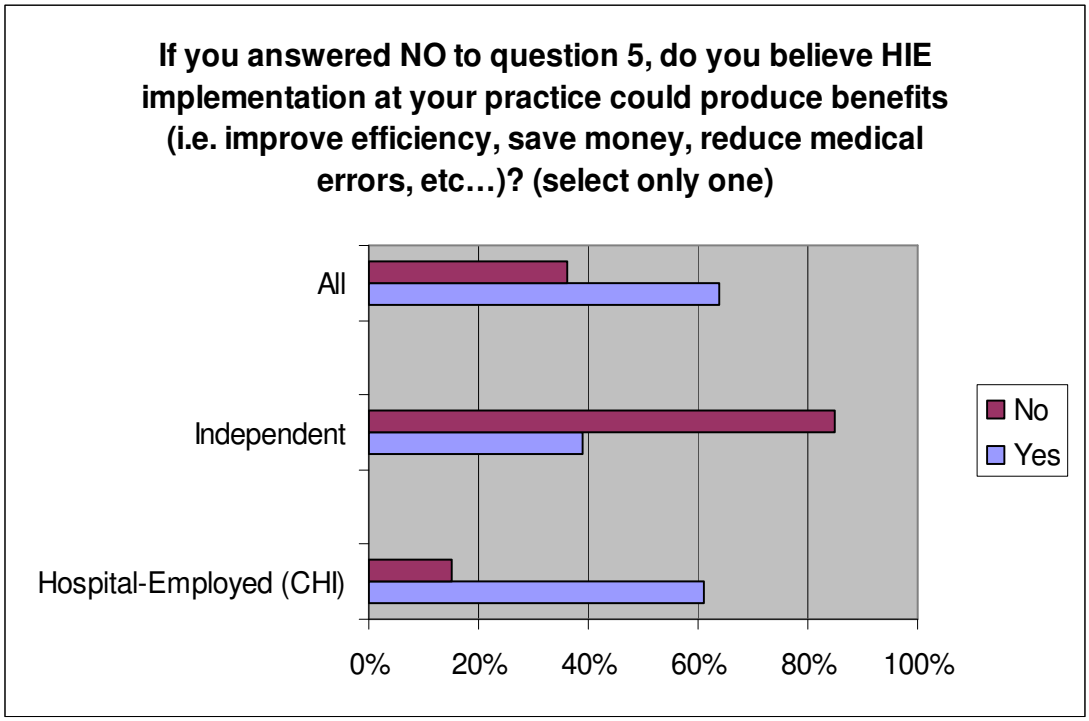
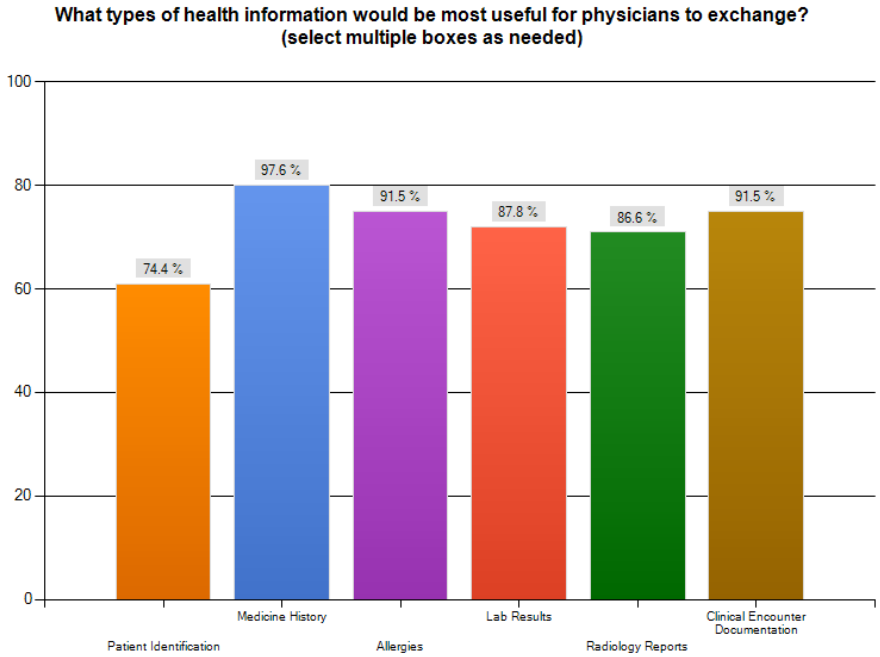


Figure 27 – HIE Benefits



Physicians provided input in Question 4 regarding the most useful types of health information to exchange between one another. Medication history was deemed most important (98%) followed by clinical encounter documentation (93%) and allergies (91%). Additionally, results showed that the least useful for exchange in our survey was patient identification (75%).

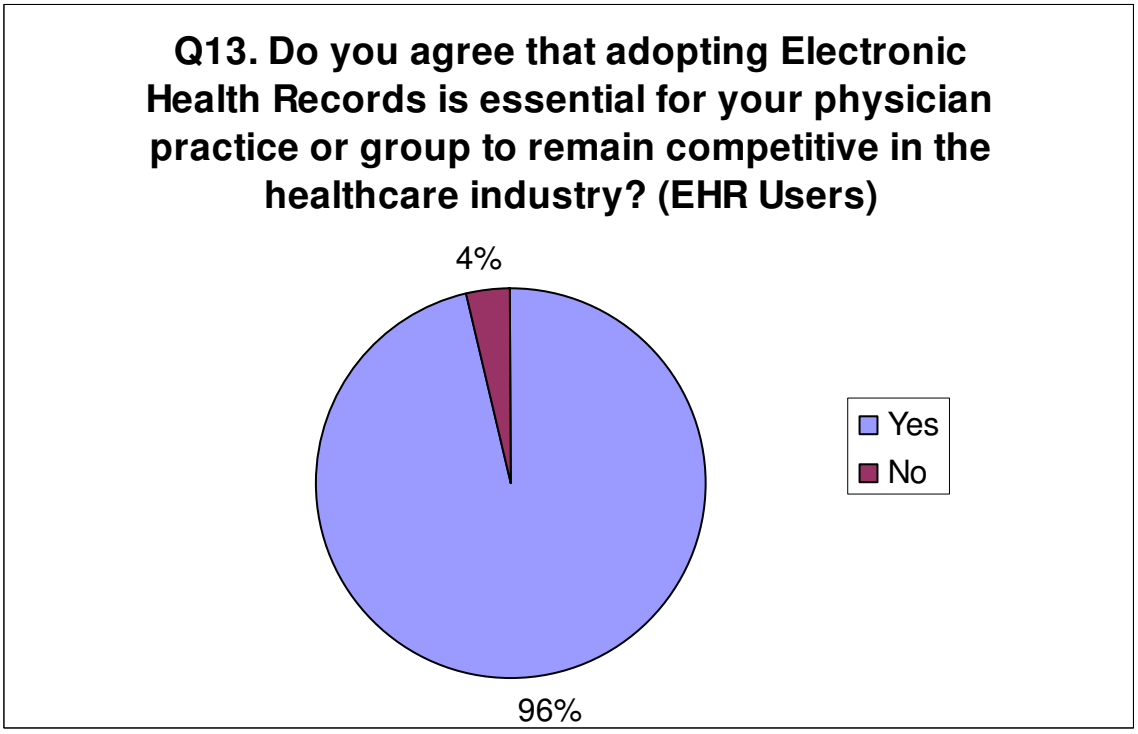


The Institute of Medicine suggests that as many as 1.5 million preventable adverse drug events occur in the United States annually.[4] The importance of knowing a patient's medication history has been often cited in healthcare literature as critical information in regards to patient safety and better quality outcomes despite the fact that it remains a chronic problem nationwide. The electronic access to patient medications is a top priority in the development of the Nationwide Health Information Network[5] and other interoperability systems, such as the HIE system between the DoD and VA. Physician survey respondents believe strongly that progress must be made in order to electronically exchange accurate and complete medication lists to improve the continuum of care. One physician stated "It is absolutely essential that we improve information sharing with health care professionals to support patient care and improve efficiency of care."

A local CHS study from the Department of Surgery published in the *Annals of Emergency Medicine* illustrates a real-world example where providers struggle daily with accurate and complete medication lists from patients. During the 13-month trial involving patients admitted to a Level I trauma center in Pennsylvania, admission trauma team medication lists derived from patients were inaccurate in 224 of 234 cases (96%). A clinical pharmacist later verified accuracy through varied sources, including telephone calls to pharmacies. Errors were found by the clinical pharmacist in medication name, strength, route, and frequency. This study showed that medication history recorded on admission was inaccurate in this trauma setting.[5]

Results from Question 13 are very important when predicting future physician adoption of electronic health records in the Conemaugh region and potentially nationwide. Overall, 72% of physician respondents agree that to remain competitive in the industry they must adopt EHRs. Researchers then performed an additional analysis by adoption group as pictured below. It is clear that current EHR users are pleased with the benefits that the technology has provided to them whereas 38% of non-EHR users believe EHRs are not needed to remain competitive. It is evident that physicians know they'll need to adopt EHRs in the future for survival whereas current users of HIT agree more strongly than non-users.

Figure 29 – EHR Adoption



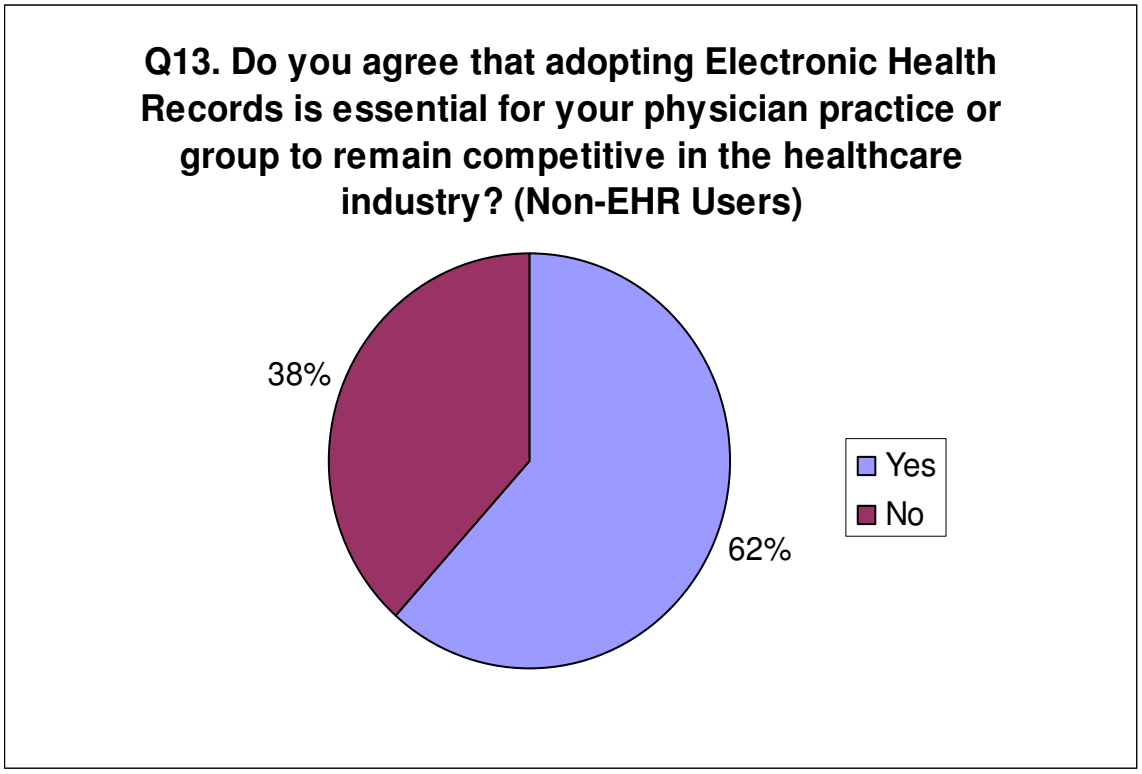
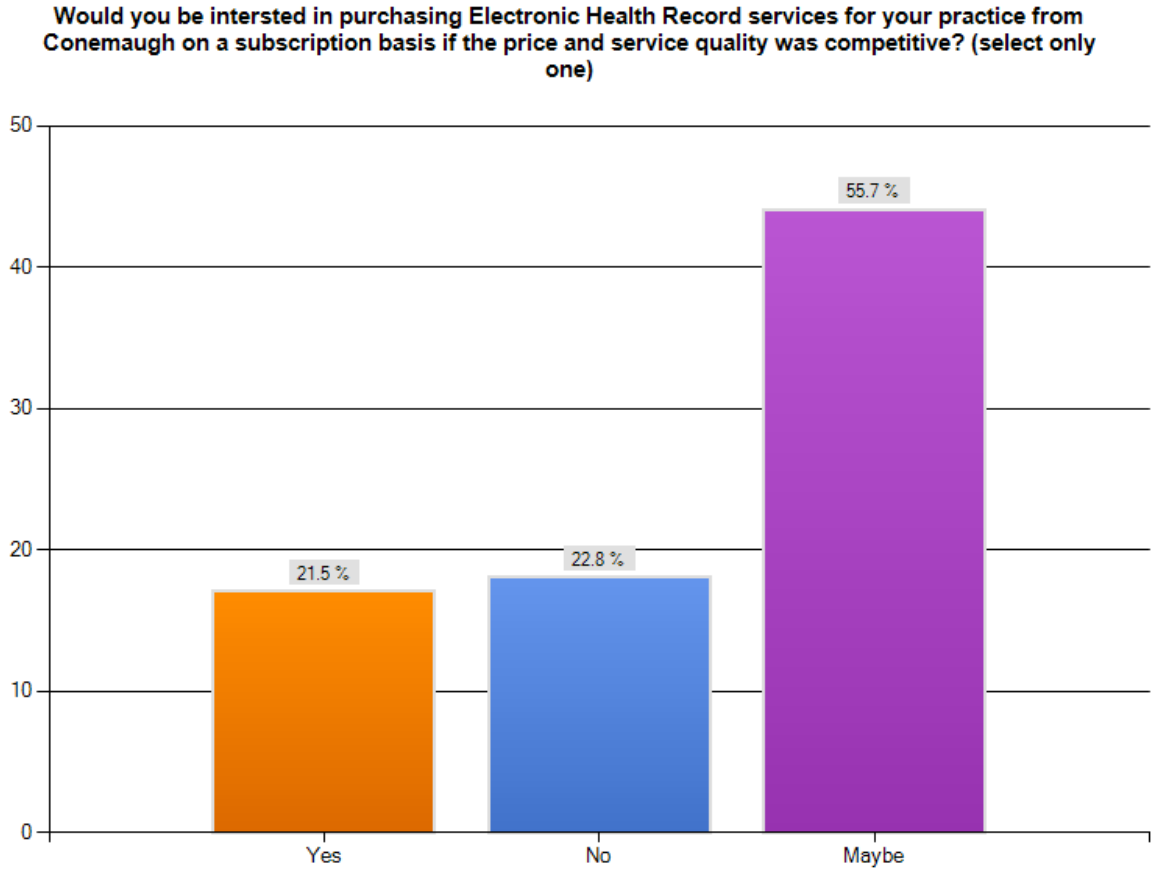


Figure 30 – EHR Procurement



The survey results above state that many Conemaugh physicians are considering adopting EHR's. Interestingly, almost two thirds of non-EHR users believe they must adopt this technology in the future to remain competitive. The research team feels that many more physicians are becoming aware of EHRs and consequently are performing their own research to determine the best option for their practice. Survey responses were received before announcement of the EHR incentives contained within the HITECH Act signed into law by President Obama in early 2009.

Finally, table 10 identifies key terms used by Conemaugh physicians in the open-ended discussion question regarding electronic health records and helps us further understand their opinions on the issue.

Table 10 – Key Terms

Similar Terms	# of times used in comments	Similar Terms	Unique Individuals	%
EHR/EMR	28	EHR/EMR	18	67%
Care/Pt Care	10	Cost/Financial/Paying	5	19%
Cost/Financial/Paying	10	Purchase(ing)	4	15%
Patient(s)	5	Information xchg/sharing	4	15%
Government	5	Patient(s)	3	11%
Standards	1	Pay for performance	3	11%
Pay for performance	4	Care/Pt Care	2	7%
Purchase(ing)	4	Government	2	7%
Information xchg/sharing	4	Efficiency	2	7%
Efficiency	3	Care Portal	2	7%
Care Portal	2	Participate	2	7%
eRx	2	Reimbursement	2	7%
Participate	2	Technical Support	2	7%
Reimbursement	2	Transcription (e.g. Dragon)	2	7%
Technical Support	2	Standards	1	4%
Transcription (e.g. Dragon)	2	eRx	1	4%
Frustrating	1	Frustrating	1	4%
Obstacle	1	Obstacle	1	4%
Quality	1	Quality	1	4%
Safety	1	Safety	1	4%
Security	1	Security	1	4%
Affordable	0	Affordable	0	0%
Barriers	0	Barriers	0	0%
Complex	0	Complex	0	0%
Confidentiality	0	Confidentiality	0	0%
Difficult	0	Difficult	0	0%
Dislike	0	Dislike	0	0%
eVisit/consult	0	eVisit/consult	0	0%
ePrescribe	0	ePrescribe	0	0%
Health information technology	0	Health information technology	0	0%
HIT	0	HIT	0	0%
HIPAA	0	HIPAA	0	0%
Interested	0	Interested	0	0%
Legal	0	Legal	0	0%
Outcomes	0	Outcomes	0	0%
PHR	0	PHR	0	0%
Personal health record	0	Personal health record	0	0%
Price	0	Price	0	0%
Privacy	0	Privacy	0	0%
Productivity	0	Productivity	0	0%
Secure messaging	0	Secure messaging	0	0%
Training	0	Training	0	0%

Paper and electronic surveys were distributed to a mix of stakeholders within the Conemaugh Health System as defined in the protocol to collect attitudes, perceptions and readiness regarding health information technology. Please see the following table for a summary of anonymous responses by CHS board members, administrators, and clinical staff:

	HIT Surveys		Average Response Rate
	Distributed	Returned	
Board Members	70	27	32%
Administrators	75	37	
Office Managers	39	33	
Physician Support	350	74	
Totals	534	171	

Hospital Attitudes Towards Electronic Health Records and Health Information Exchange (HIE)

One hundred seventy one (171) board members, hospital administrators, office managers and physician support personnel provided informed consent by completing the anonymous survey as noted above. The goal of the survey was to collect information from non-physician stakeholders within CHS regarding their current use, understanding and support of health information technology (e.g. EHRs, HIE) and determine attitudes, perception, and readiness thereof.

In summary, stakeholders believe the most important benefit to achieve through HIE is to improve efficiency (90%), followed by reducing medical errors (70%) and saving money (49%). This result suggests that the healthcare industry consists of too much inefficiency where the lack of health information exchange and access to complete patient data results in unnecessary steps that can be potentially erased through HIE technologies.

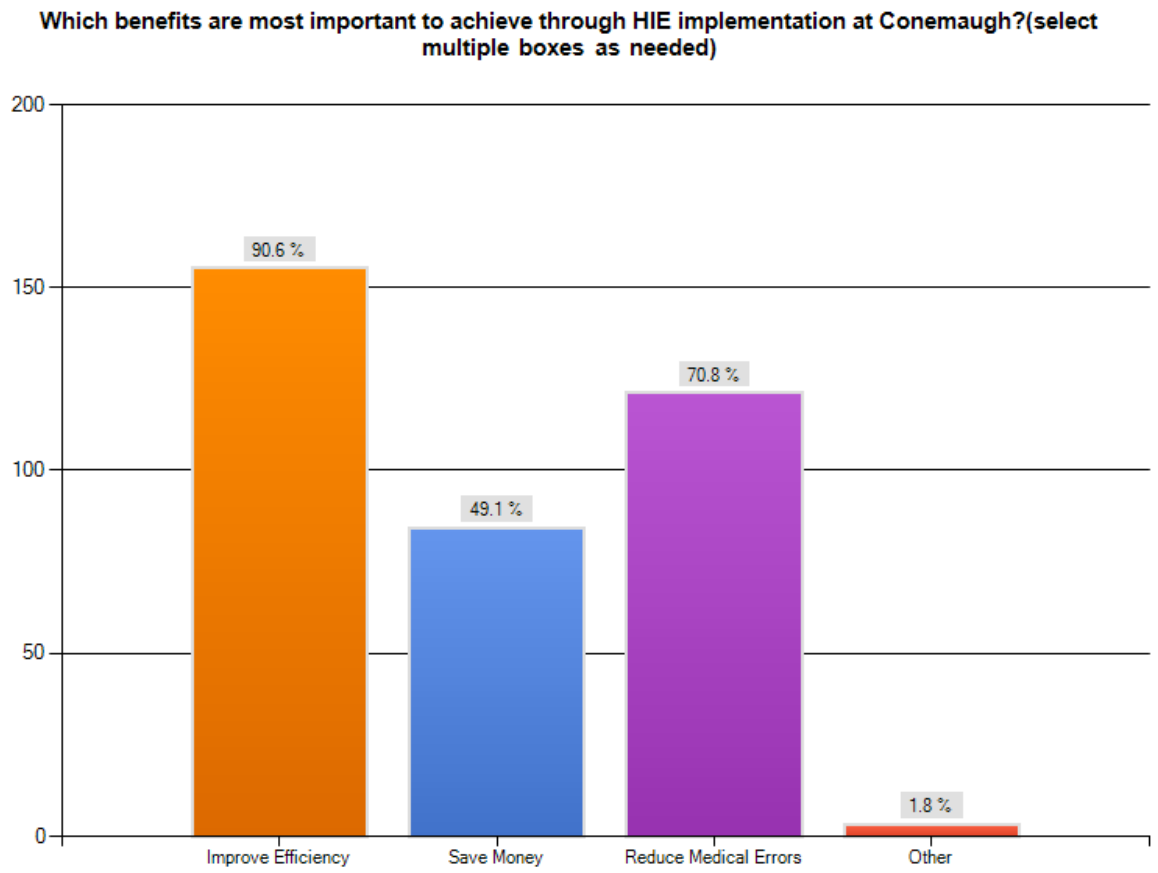
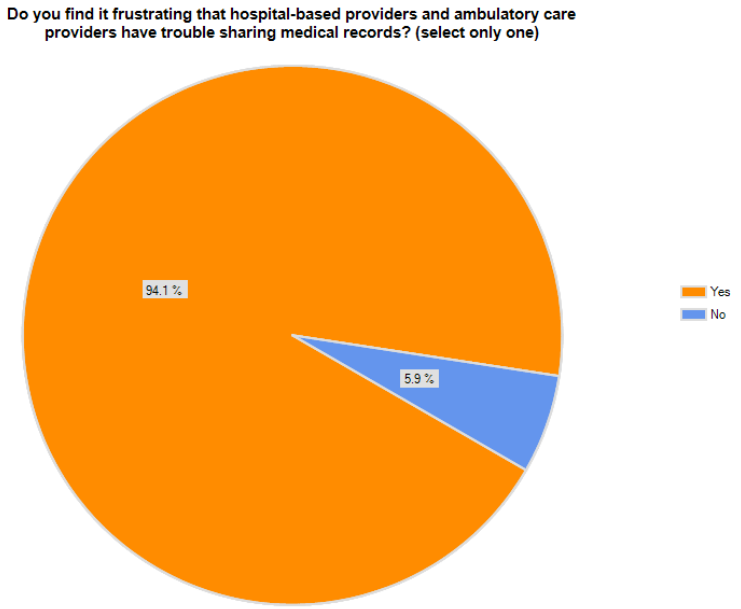


Figure 31 – HIE Benefits

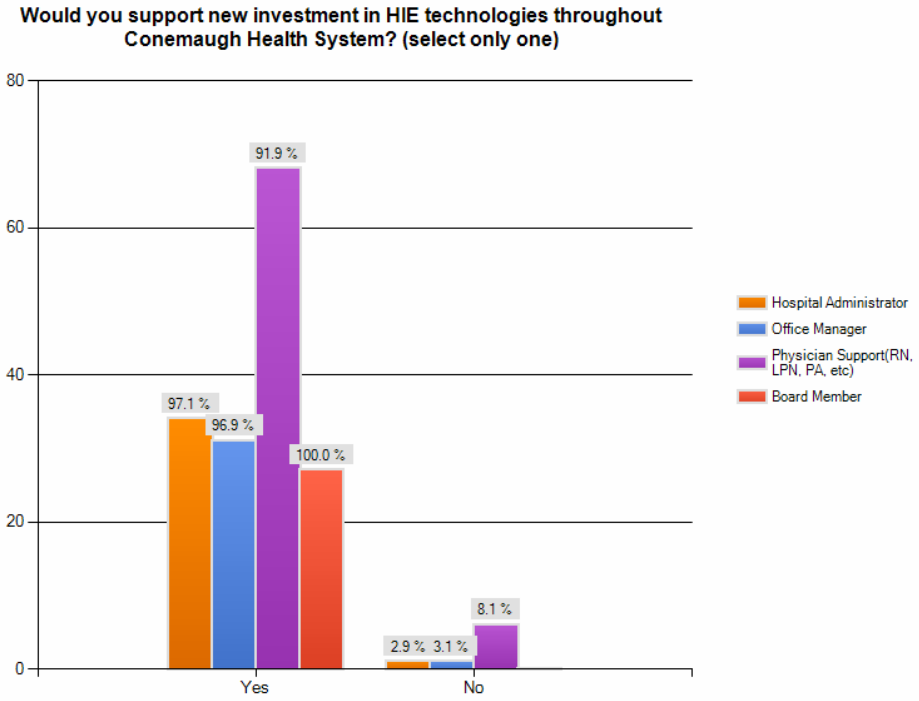
Question 9 below portrays a chronic issue in the healthcare industry that is not new. Ninety-four percent (94%) of survey respondents find it frustrating that hospital-based providers and ambulatory providers have trouble sharing medical records in a timely, efficient and productive manner. In a 2007 Medicare study published in the New England Journal of Medicine, Dr. Pham et al. predicts that the typical Medicare patient in one year sees seven different doctors, including five different specialists and two primary care physicians.[6] Furthermore, Dr. Pham et al. stated in a 2009 publication that the typical primary care physician has 229 other physicians working in 117 practices with which care must be coordinated.[7] This dynamic environment creates a problematic situation for patients and providers alike in which health information exchange can be a partial solution.

Figure 32 – Sharing Medical Records



Question 10 below suggests that all stakeholders were nearly unanimous in their support of new investment of HIE technologies throughout Conemaugh Health System.

Figure 33 – Support New Investment



3. Current state of HIE – TRICARE provider perspective

This survey was designed to understand the current state of health information exchange between private sector TRICARE providers and the DoD for military beneficiaries being treated in multiple healthcare systems. Survey respondents were a subset of CPG providers and each Emergency Department within CHS as shown below.

Facility	TRICARE Surveys Returned	Total
MMC Emergency Dept	1	12
MiMC Emergency Dept	2	
MyMC Emergency Dept	2	
Portage Health Center	4	
NORCAM	1	

According to Question 7 results on the following page, Conemaugh providers in the private sector do not normally have access to patient health information that originated from the Military Health System as 83% stated "Never" or "Rarely." These results are concerning for continuity of care purposes and may lead to rising costs, duplicated tests, adverse events and patient safety issues. Department of Defense officials state that as much as 74% of military beneficiaries seek care in the private sector depending on service as displayed below.[8]

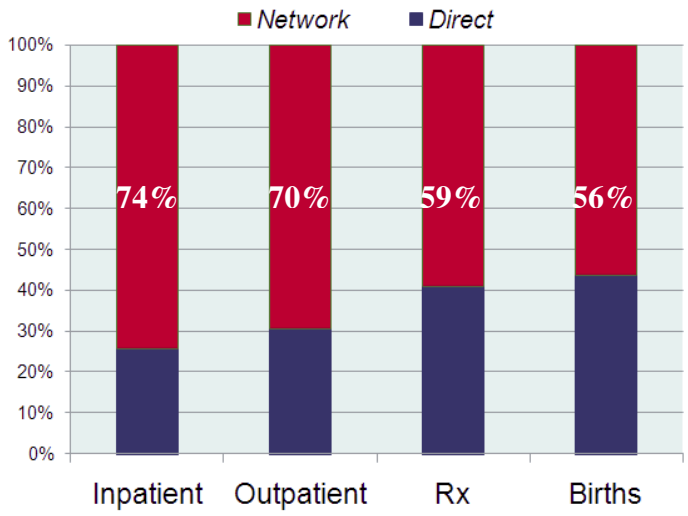
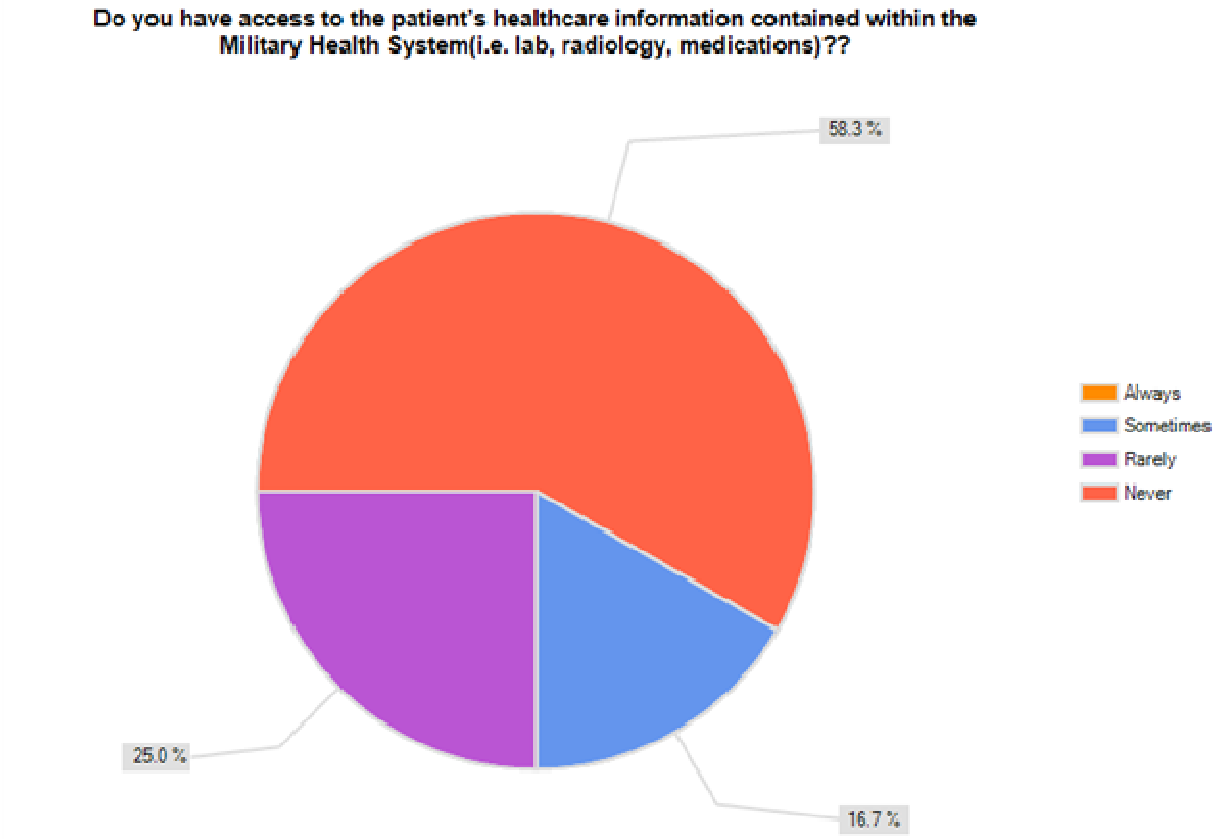


Figure 34 - Source: LCDR Steffensen, CONNECT Seminar 2009

Figure 35 – Access to MHS health records



If applicable, providers are receiving patient health information "most often" by fax (40%), hand delivery (33%), phone (22%) and EMR (11%). Researchers believe the selection of EMR is an error because interoperability between EMR systems did not exist when surveys were completed in early 2009. There is a significant opportunity to enhance patient care of military beneficiaries through implementation of bi-directional electronic health information exchange via the NHIN CONNECT open source gateway that ideally will connect federal agencies with hospitals, physician offices, pharmacies, labs, etc. in the private sector.

Comparing the Effectiveness of an HIE and Lightweight EHR Implementation to more Traditional EHR and EMR Implementations in both Rural and Urban Settings

Overview

In 2004, President George W. Bush set a goal that most Americans will have access to electronic health records (EHR) by 2014.[9] He envisioned a connected healthcare arena where physicians share and have access to a patient's laboratory results, radiology results and images, use computerized ordering, and create electronic prescriptions. Currently, patients move from physician to physician and from hospital to hospital, thus making it harder to maintain a continuum of care for the patient and the healthcare provider. Using an EHR or EMR (electronic medical record) provides access to the most up to date information and helps to maintain the patient's continuity of care.

Electronic Health Record (EHR)

An EHR refers to an individual patient's medical record in digital format. Electronic health record systems coordinate the storage and retrieval of individual records with the aid of computers. EHRs are usually accessed on a computer, often over a network. It may be made up of electronic medical records (EMRs) from many locations and/or sources. A variety of types of healthcare-related information may be stored and accessed in this way.

The Institute of Medicine (IOM) committee (2003) lists the core functionality of EHRs as:

- Health Information and Data
- Results Management
- Order Entry/Management
- Decision Support
- Electronic Communication and Connectivity
- Patient Support
- Administrative Processes
- Reporting and Population Health Management

A traditional EHR provides all of these components while a lightweight EHR provides some, but not all, of these features.

Lightweight EHR

A lightweight EHR is an electronic health record product that is aimed towards physicians and small practices that do not have the communications bandwidth in rural settings necessary to support a full-size EHR, or are not willing to make the commitment for a full-size EHR such as Epic. Common characteristics of lightweight EHRs are the following:

- Web-based, supports low bandwidth (dial-up) connections
- Geared towards ambulatory settings, not inpatient settings
- Mechanism to view lab or radiology results, etc., from other locations via health information exchange
- Rudimentary capability for documenting encounters
- Does not support computerized patient order entry (CPOE)
- Document management through scanning and imaging, makes paper artifacts more easily accessible rather than fully replace them
- No decision aids and support (knowledge bases, recommendations, reminders) offered by full-size EHRs

Lightweight EHRs often function in health exchange organizations where some sites may use one (or more) full-size EHRs, but there is a need for a commonly available client across ALL points of care in a region. Therefore, lightweight EHRs do not preclude the use of full-size EHRs, but do provide a "lowest common denominator." It offers a way to increase adoption rates among providers by removing the need to commit to the full EHR.

To date, Lightweight EHRs have been born of necessity to support data exchange between practices and groups that do not require a large integrated EHR. They have not been built to a particular standard, but rather have reflected the requests of care providers. They are usually bundled with a service provider's offering, and not as a stand-alone utility. Data available to an EHR typically address some of the following elements of a Continuity of Care Record:

- Patient Demographics
- Diagnoses
- Allergies
- Medication list
- Lab Results
- Radiology Reports

Benefits and Key Success Factors

The reasons for implementing an EHR are the hope that it will reduce medical errors, improve patient care, improve workflow within the office, and facilitate the sharing of patient data among physician offices and hospitals. In this aspect it is harder to find the differences between rural and urban providers. Studies have shown that order-entry systems can reduce medical errors because it eliminates the need to interpret the provider's handwriting. Many EHRs have included decision support into their functionality to help alert physicians to medication conflicts.[10-11] These EHRs also allow a patient's prescription to be renewed faster and more efficiently since the medication information is easily retrieved. This in turn, helps to reduce the amount of time that physicians and staff need to perform these activities.

Electronic health records are useful for identifying patients affected by recalls. For example, when drugs are recalled, physician's offices can readily retrieve patient information and notify affected patients to discontinue taking the medication as well as prescribe a new medication. There can also be more efficient communication among staff when using an EHR. When a patient calls the practice with a question, the staff member can view the EHR for prior information instead of taking the time to ask the patient or staff members the same questions. Building reminders into EHRs allows the physician, for example, to remind the patient to schedule a mammogram or colon screening.[12] Studies have shown that once a EHR is implemented and users become familiar with the application, the workflow within the office is more productive.[13-14] The medical practice of Greenhouse Internists stated that "despite the difficulties and expense of implementing the EHR, none of us [the internists] would go back to paper."[15]

Barriers and Key Risk Factors

Research shows that both urban and rural physicians have stated that one of the biggest barriers to implementing an EHR is cost.[10] Studies have demonstrated that, as the size of a practice grew the cost of implementation decreased but was still a major factor.[9-10] However, in rural areas where many practices are small, cost remains the biggest barrier to implementation.[13] Many rural physicians and hospitals also have related technology issues, such as limited or no internet access and/or staff with inadequate skills to use the technology effectively. Some offices may have space limitations where the size of the examination room is too small to install a computer or a computer system. Larger urban practices or hospitals usually do not have the same issues because they have a technology base in place and they have a larger pool of staff members who have the skills and know-how to use technology efficiently.

Both rural and urban offices have concerns regarding EHR implementations as it pertains to security and privacy.[14-15] Many EHRs have audit trails that can be accessed by the technology staff as well as providing for regular checks and backups on a routine basis. Another concern was the cost of interfacing with other entities, laboratories, radiology systems and other hospitals or physicians. Interoperability ranked among one of the highest barriers for both the urban and rural areas. Ease of use and acceptance from physicians was another barrier that was significant to both the urban and rural areas.[14,16]

Cost of Implementation

Many factors need to be considered when trying to determine the cost of implementing an EHR. There are hardware and software costs, training and implementation costs, and supply costs needed for using the EHR. These costs are usually easily calculated; however, the harder part of determining the cost of implementation is that related to lost productivity and patient dissatisfaction while staff members learn the system. There are also costs that are often over looked or deemed unnecessary until the implementation is underway, such as maintenance and new dedicated EHR staff when it is determined that existing staff cannot perform the necessary

duties to maintain the EHR. Studies have shown that the costs can range from $20,000 to $80,000 per user per year.[9,11,16]

Larger metropolitan practices are further along in EHR implementations than are the smaller rural practices.[16] An October 2007 study conducted by the Centers for Disease Control and Prevention found that approximately 25% of practices with 11 or more physicians used a traditional EMR. This represents approximately 8% of physicians. Single practices, which approximately half of all physicians fall into, have reported a much lower rate use of a traditional EMR at 7.1%. Those with a partner had a usage rate of 9.7%.[12]

Maintenance Costs

Maintenance costs can be difficult to ascertain and calculate as many factors need to be taken into consideration. Most people think only of the hardware and software costs necessary to maintain the system; but maintenance costs related to ancillary devices such as printers and personal computer systems need also be considered.

Greenhouse Internists of Philadelphia decided to purchase an EHR when their malpractice carrier changed from occurrence to claims made coverage. They found that their implementation cost with 1 year support would be $140,000 in 2005, which compared to the range of their research.[13]They previously had contracted with a local provider to support their existing computer hardware before the EHR implementation. When they implemented their new EHR, they cancelled the existing contract since both the hardware and software they purchased for the new EHR were covered by maintenance plans. However, when their new system failed, they found themselves turning to the local support provider to provide on-site support because of slow response time when technical support was needed. In 2005, their annual local support contact was an additional $2,000 per month, which was not a cost that they had budgeted for initially.[13]

The costs associated with new personnel required or current personnel with new responsibilities as a result of an EHR implementation needs to be considered. Larger practices or hospitals may require dedicated day-to-day support of the EHR which may require additional staff. Smaller practices may need to hire people with additional skills or pay existing staff more due to increased responsibilities.

The costs of eliminated items should also be factored into the cost of the EHR, such as positions eliminated because of the system. Costs of supplies such as paper, folders, and fax lines, no longer necessary with the new EHR, need to be considered as well.[11] Other considerations are the space within an office that changes because of the system. Some offices stated that once the EHR was in place and the old paper records were converted into electronic records, they had extra space, which they converted into additional exam rooms, office space, conference rooms, or computer networking rooms.

Training Impact and Estimated Training Costs

Some of the bigger issues for training in rural areas were the lack of time that personnel had to learn new technologies and the complexity of the system. In smaller practices, it became difficult to train personnel since the entire office had to close or they had to eliminate patient appointments to accommodate the training, resulting in loss of productivity and revenue.

Another factor offices must consider is the computer expertise of the staff.[13] Some staff members may not have used a computer, laptop, notebook, or mouse prior to the installation of the EHR. This will greatly reduce the speed and effectiveness of using the system at first.[15] As the users of the EHR become more familiar with the application and the system, the speed and productivity should increase.

Another training impact involves those who maintain the system. Is someone within the office expected to do upgrades for the computers and the network? Is this person also responsible for doing the backups and the audits of the information that is stored? This may result in a longer training period with time spent away from the practice. Their duties change from the normal workflow within the office.

Workflow

When evaluating EHRs the physician's office or hospital must have a clear vision of what they expect from an EHR. Rural areas also need to consider the networking capabilities within their area. If there is no high-speed internet access, getting results or information into or out of their EHR may be so slow that it makes the workflow cumbersome.[13] Practices should consider each person's role within the office when implementing an EHR; most, if not all, roles and workflows will change because of the system.

Things that worked in the past may or may not work as well once the EHR is implemented. Space consideration and changes to the work environment also need to be evaluated in relation to the EHR implementation.[10] There may not be enough workspace in an exam room for a full size computer, so notebook computers may need to be considered.

Conclusion

Although the President has stated that EHRs should be in place by 2014, implementation has been slow because of cost, technology, and other barriers. The high cost of EHRs has greatly affected the implementation of EHRs because of the slow return on investment (ROI). The initial productivity loss in a physician office or hospital has been a main consideration to implementing an EHR.

It is difficult to determine the differences in rural and urban areas with EHR implementations due to the lack of documented cases, but there are some distinctions in the size of practices and hospitals. The smaller the hospital or practice the bigger the barrier and the more rural the

setting, the bigger the technology constraints might be. There are some areas where distinct differences can be identified, including the cost of implementation, training, and the technology capabilities within the rural communities.

The term lightweight EHR is also difficult to define because each institution can choose the areas of the core traditional EHR functionality that they wish to implement, thus changing metrics, barriers, and benefits each institution hopes to analyze. Both the urban and rural communities hope to reduce medical errors as well as improve patient care by having the patient's records readily available with the use of an EHR. Although there are barriers to implementing EHRs with the more funding, established standards, and the lessons learned from early adopters, the use of traditional and lightweight EHRs will gain strength and become more widely accepted.

Users will have to accept new technology and the fact that office workflow, as they know it will change with the implementation of any system. The sharing of patient information through an EHR will allow physicians, office staff, hospitals, to improve patient care by reducing medical errors and providing a more efficient workflow.

Market Review of Existing GOTS Solutions and Requirements Mapping for Rural Health

A market review of existing Government off-the-shelf (GOTS) solutions has been performed by subcontractor Northrop Grumman. The following GOTS solutions were analyzed, as well as how they could potentially map to the technical and functional requirements for the MIDHT project:

- Theater Medical Information Program
- Personal Information Carrier
- Electronic Information Carrier
- AHLTA Mobile
- AHLTA
- AHLTA Theater

Background

In response to the ensuing health problems faced by the veterans of the 1991 Persian Gulf War, as well as the apparent lack of consistent recordkeeping in the battlefield, the Presidential Advisory Committee on Gulf War Veterans' Illnesses was formed in 1995 at the direction of then-President Bill Clinton. As stated in the Executive Summary of the National Science and Technology Council (NSTC), "This Committee was to ensure an independent, open and comprehensive examination of health concerns related to Gulf War service."[18] The PAC recommended that an interagency plan to address the healthcare needs for veterans and their families be implemented. This plan, in turn, spawned Presidential Review Directive (PRD)/NSTC-5, which directed the Department of Defense (DoD), Veterans Affairs (VA) and Department of Health and Human Services (DHHS) to come up with a plan to address these healthcare needs. It is because of this directive that the Theater Medical Information Program (TMIP) and its subsequent components were developed

Theater Medical Information Program (TMIP)

PRD/NSTC 5 specifically required the DoD to develop "a standardized, integrated, and seamless system of medical command for the military medical community within the Global Command and Control System."[18] The DoD met this requirement by creating the TMIP. The TMIP is not a single software system, rather a fully integrated suite of medical information systems that provide support and information for deployed medical forces. The system as a whole allows medical professionals to have access to a soldier's updated military healthcare record at any point in time. Software products pertinent to the flow of patient information for the MIDHT project that fall under the TMIP umbrella include:

- Personal Information Carrier
- Electronic Information Carrier

- AHLTA Mobile
- AHLTA
- AHLTA Theater

TMIP, in its entirety, was first used by the Army in 2003 during Operation Enduring Freedom and Iraqi Freedom.[19] Though some of the systems within TMIP functioned slowly in the beginning, the usefulness outweighed the issues.

Personal Information Carrier (PIC)

The PIC was one of the first components developed as part of the TMIP program. Physically, the PIC is a small, portable, electronic device designed to be about the size of traditional dog tags. Each PIC has the capacity to store anywhere from 8 to 128 megabytes of essential medical information about the soldier, such as patient demographics, personal health records, vaccination status, and x-rays. Medical information is loaded on the PIC prior to the soldier's deployment, and can be viewed and updated by medical personnel if the soldier is examined or treated while in the theater via a Personal Computer (PC) Card Port Adapter connected to a hand-held device or portable computer. The need for a PC Card Port Adapter in order to transmit or update information from the PIC is a major limitation of the device.

Figure 36 - Personal Information Carrier (compared in size to a set of dog tags)

Electronic Information Carrier (EIC)

To overcome the limitations of the PIC, the EIC was developed. The EIC is also a small, portable, electronic device, but does not require any physical contact to transmit the data contained on it to another device. Information stored on the EIC can be transmitted wirelessly, and securely, up to ten yards from a patient or a soldier that is wounded in the battlefield. Transmission is accomplished by a HotSync action, similar to that of transferring information between a personal digital assistant (PDA) and a PC. The EIC can also be connected to a PC via a universal serial bus (USB) port in the event that wireless connectivity is not available. In addition to storing the same patient information as the PIC, the EIC can store up to twenty years of medical records, and also has the capability to store digital radiology images and ultrasounds.

Figure 37 - Electronic Information Carrier
(compared in size to AHLTA Mobile on a handheld, and a quarter)

AHLTA Mobile

AHLTA Mobile, previously known as the Battlefield Medical Information System Tactical (BMIST), was developed by The Telemedicine and Advanced Technology Research Center (TATRC). The AHLTA Mobile software was developed specifically for Special Forces medics and military first responders and is loaded on a hand held device for use at the point-of-care. AHLTA Mobile contains features that allow the first responder to document a medical encounter quickly and with accuracy, while enabling military providers to record, store, retrieve and transfer medical records to the DoD's Clinical Data Repository (CDR).[20] In addition to allowing data capture, AHLTA Mobile also contains the Special Operations Forces Handbook, a medical reference which provides step-by-step instructions for diagnosis and treatment of illnesses and injuries. Data that is stored on a PIC can be easily transmitted to AHLTA Mobile by inserting the PIC into a PC Card Port Adapter, while data stored on an EIC can be wirelessly transmitted to AHLTA Mobile. Information that is entered or updated via AHLTA Mobile can then be transmitted to AHLTA Theater in order to ensure that the soldier's permanent records are always updated and accurate.

Figure 38 - AHLTA Mobile (loaded on an iPAQ pocket PC)

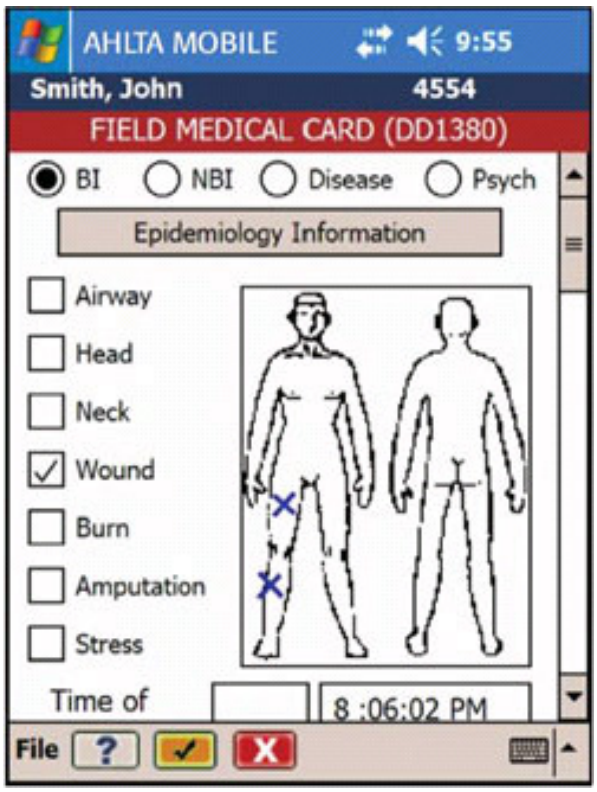


Figure 39 - AHLTA Mobile – showing an Electronic Field Medical Card

AHLTA

In President Bush's 2004 State of the Union address, the goal for most Americans to have an EHR by the year 2014 was set. The DoD was well ahead of this effort with its creation of AHLTA, the DoD's EHR, formerly known as the Composite Health Care System (CHCS). AHLTA is an enterprise-wide medical and dental clinical information system used by military medical providers. Utilizing AHLTA, military health system (MHS) providers are able to document a patient's health history and medical encounters, which are then stored in a single database known as the CDR. This gives the provider secure online access to a soldier's longitudinal military healthcare records, as AHLTA is also able to pull back data stored in the CDR updated by medical systems used in the theater. AHLTA offers Computerized Provider Order Entry (CPOE) capabilities with an intuitive graphical user interface (GUI) front-end to further expand the provider's ability to provide comprehensive medical care for their patients. Currently, AHLTA holds the health records of 9.2 million military personnel, family members and retirees. In addition, AHLTA 3.3 has been pre-certified by the Certification Commission for Healthcare Information Technology (CCHIT), a not-for-profit organization that sets standards for EHR systems in an effort to aid in adoption of health information technology (HIT).

AHLTA Theater

In 2003, a scaled-down version of AHLTA, the CHCS II T or AHLTA Theater, was introduced on the battlefields of Operation Enduring Freedom and Iraqi Freedom. AHLTA Theater was developed to allow medical personnel in Level II and Level III military treatment facilities (MTFs) to document clinical encounters in the same type of format as documented in AHLTA. The use of AHLTA Theater on the battlefield contributes to a comprehensive, durable medical record for each war fighter that includes all of his medical encounters. All information entered into AHLTA Theater is ultimately stored in the same CDR as information entered in AHLTA.

Requirements Mapping to MIDHT

In its simplest form, the MIDHT project will create a means by which a soldier's complete military medical history can be shared with civilian providers that need access to the information in order to provide the most comprehensive care possible. A soldier's medical information is typically passed through several GOTS systems before it reaches the CDR, where it is permanently stored. Post-MIDHT implementation, CHS will have access to the soldier's medical record in the CDR via the Northrop Grumman health information exchange (HIE) platform. The following diagram, and corresponding explanation, demonstrate how this information will flow, allowing the requirements of the MIDHT project to be met.

Flow of patient information from battlefield to CHS

1. PIC or EIC: A deployed soldier's essential medical information can be loaded on these devices pre-deployment. The pre-loaded information is then available for viewing/updating, via AHLTA Mobile, if the soldier is injured in the battlefield during deployment, or during post-deployment physicals. Medical information loaded on a PIC or EIC may include, but is not limited to:

    - Patient demographics
    - Personal health record
    - Vaccination record
    - Allergies
    - Medications
    - Radiology reports, Ultrasound images, Digital Radiology images
    - Lab reports
    - EKGs

2. AHLTA Mobile: All medical information from the PIC or EIC for a deployed soldier is transmitted to AHLTA Mobile via a PC Card Port Adapter (PIC) or wirelessly (EIC). This information can then be viewed on AHLTA Mobile at the point-of-care (e.g. on the battlefield). Medical information transmitted to AHLTA Mobile, as well as any information updated directly on AHLTA Mobile at the point-of-care, is stored on the mobile unit until communications are available for the information to be transferred to AHLTA Theater.

3. AHLTA Theater: AHLTA Theater can be used to view medical information that has been transferred from AHLTA Mobile, as well as any information that has been input directly into the software from use in the theater. AHLTA Theater enables the healthcare provider(s) to document medical care given, order labs such as blood work, x-rays, or medications, and store medical data until communications are available to send the data to the Theater Data Medical Store.

4. Theater Data Medical Store (TDMS): Medical information from AHLTA Theater is transmitted to the TDMS, as well as to the CDR for inclusion in the soldier's complete longitudinal health record.

5. CDR: The CDR is the component of AHLTA which stores patient health care history for all military personnel. Medical information from AHLTA is uploaded to the CDR in real-time. Information from AHLTA Theater is uploaded to CDR when connectivity is or becomes available.

6. AHLTA: AHLTA is used to access/update military personnel records within the MHS. The medical information held in AHLTA is pulled from the CDR, and will be pushed back to the CDR real-time when updates have been made to a record.

7. Northrop Grumman HIE Platform: The Northrop Grumman HIE platform is the gateway that connects CHS to medical information in AHLTA.

8. CHS: Physicians at CHS can access the Northrop Grumman HIE Platform in order to view pertinent medical information for their patients' military medical record, thereby allowing them access to a complete health care record.

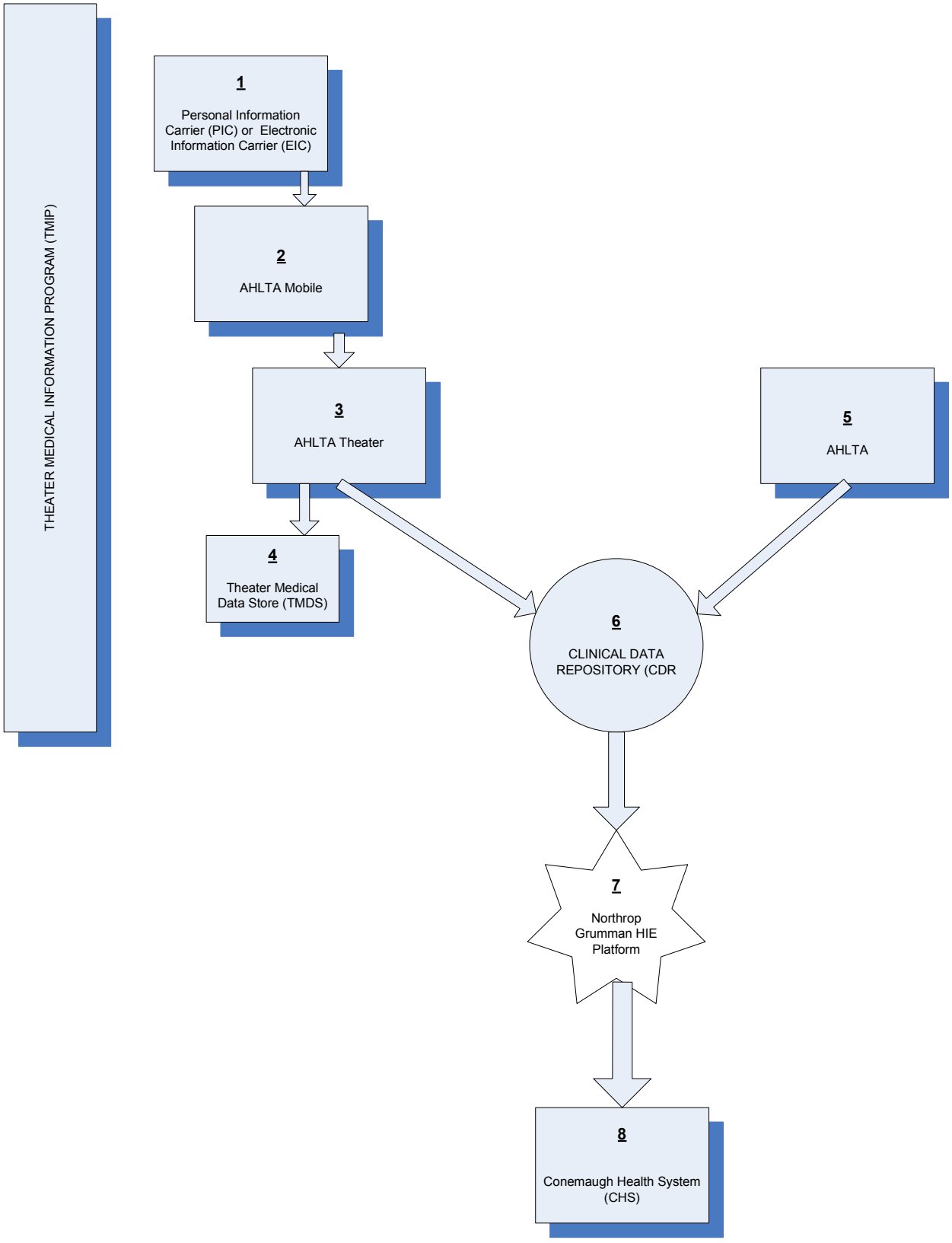


Figure 40 – Flow of Information

Arm 2: The Impact of Consumer Informatics in the Chronic Care Model: Metabolic Syndrome in a Rural Setting (Study A-14465.1)

The Chronic Care Model (CCM) was developed by Dr. Edward Wagner as a means to combat the rising number of persons living with chronic conditions (estimated at 133 million people) due to an aging population and higher life expectancy rates. More importantly, traditional healthcare delivery systems have been designed for acute illnesses and largely do not meet the needs of millions of Americans coping with chronic diseases, such as diabetes, hypertension, obesity, and congestive heart failure. The model, as pictured below, identifies the essential elements of a health care system that encourage high-quality chronic disease care. These elements are the community, the health system, self-management support, delivery system design, decision support and clinical information systems. Evidence-based change concepts under each element, in combination, foster productive interactions between informed patients who take an active part in their care and providers with resources and expertise.[21] Our study tried to incorporate many of the CCM concepts using consumer informatics to aid in community outreach, decision support, and self-management.

This research study, which received MMC IRB approval on 25 April 2008 and USAMRMC IRB approval on 10 June 2008, measured the impact of consumer informatics in the Chronic Care Model; metabolic syndrome population over two counties in SW Pennsylvania. Metabolic syndrome is a pre-cursor to Diabetes, Heart Diseases and other serious conditions. The use of VTC allowed trained staff to reach three sites simultaneously to provide nutrition counseling and exercise instruction to the enrolled research subjects.

Registered dietitians from the Conemaugh Diabetes Institute as well as an exercise physiologist created a Lifestyle Intervention Program for this study. The program was designed to place an equal emphasis on healthy eating habits and exercise in order to prevent the onset of diabetes in persons who are at risk. A unique aspect of the Lifestyle Intervention Program is the *Nutrition and Fitness Journal* website. Subjects were able to record their daily food intake and exercise into an online diary to receive instant feedback on caloric intake and expenditures, rather than the traditional paper and pencil method of recording these figures.

Beginning in July 2008, subjects were recruited through traditional means, including physician mailings and referrals, global emails to hospital employees, newspaper advertisements, and word of mouth. To be included in the study, potential subjects must meet the American Heart Association's guidelines for metabolic syndrome, have daily access to the Internet, and be willing to travel to classes twice a week for twelve weeks. Research staff received over 80 inquires about the study. In August, a total of 50 subjects were consented and screened at the three locations where classes would be held (MMC, MyMC, MiMC). Of the screened subjects, 46 met the inclusion criteria and were enrolled into the study. At the screening visit, the enrolled subjects completed a Readiness to Change Questionnaire that will was used during data analysis. In addition, the research team collected subjects' weight, waist circumference, BMI, body fat, blood pressure and hemoglobin A1C, glucose, triglycerides, and HDL cholesterol from lab studies to serve as baseline measurements. These measurements were repeated again after the 12-week intervention to measure changes in the respective health outcome measures.

The classroom instruction consisted of two classes per week (Tuesday and Wednesday evenings) taught by registered dietitians and an exercise physiologist for a twelve-week period. Enrolled subjects used the online journal daily to record their diet and exercise for the day. The research team monitored subject's compliance with the journal usage and contacted subjects if a problem occurred or if there was noncompliance. At the end of the 12-week intervention, subjects and educators completed a questionnaire evaluating the use of VTC to provide/receive the Lifestyle Intervention Program.

Following the 12-week biweekly classroom instruction, subjects continued to use the Nutrition and Fitness Journal website to track their diet and exercise on a daily basis. Again, subjects were notified if the research team noticed there was not compliance with entering their personal information onto the website. Following the 40 week follow-up period (occurred in September 2009), subjects again had measurements repeated and completed a questionnaire assessing their perceptions of the online journal. After the 3rd and final data collection, the study will be terminated after completing data analysis.

Video Teleconferencing Technology

VTC capability has been implemented at the following three locations:

1. Memorial Medical Center
2. Meyersdale Medical Center
3. Miners Medical Center

For Arm 2, a three-way simultaneous connection (full audio and video) with active communication between all three sites was made twice per week.

Polycom was chosen as the VTC solution by CVMH. Requirements were defined in conjunction with vendors.

- November 2007:
  - i. Specifications were defined with Polycom for the backend infrastructure
- December 2007:
  - i. Bidding and contract award for required hardware
- February 2008:
  - i. Hardware was installed and operational.
  - ii. Requirements were defined in conjunction with vendors and specifications defined with Polycom for individual VTC rooms
- March 2008:
  - i. Bidding and contract award for required hardware for the individual VTC rooms
- August 2008:
  - i. Hardware was installed, configured and operational in all individual VTC rooms

Specifically, the following infrastructure improvements and software have been successfully installed and implemented, including:

1. Dedicated hi-speed Ethernet pipes to both Meyersdale and Miners
   a. 100 Mbps EPL MiMC, Frame-relay Backup
   b. DS3 MyMC, Frame-relay
2. Polycom HDX codecs
3. Polycom RMX-2000 Bridge
4. Polycom v2iu Nat/Firewall traversal
5. Polycom Ready Manager (conference manger, scheduler, gatekeeper)
6. Polycom Management software

Additionally, configuration adjustments were developed, tested and instituted so that not only the Polycom installations but also the Tandberg VTC system (located at Miners) would operate efficiently and effectively.

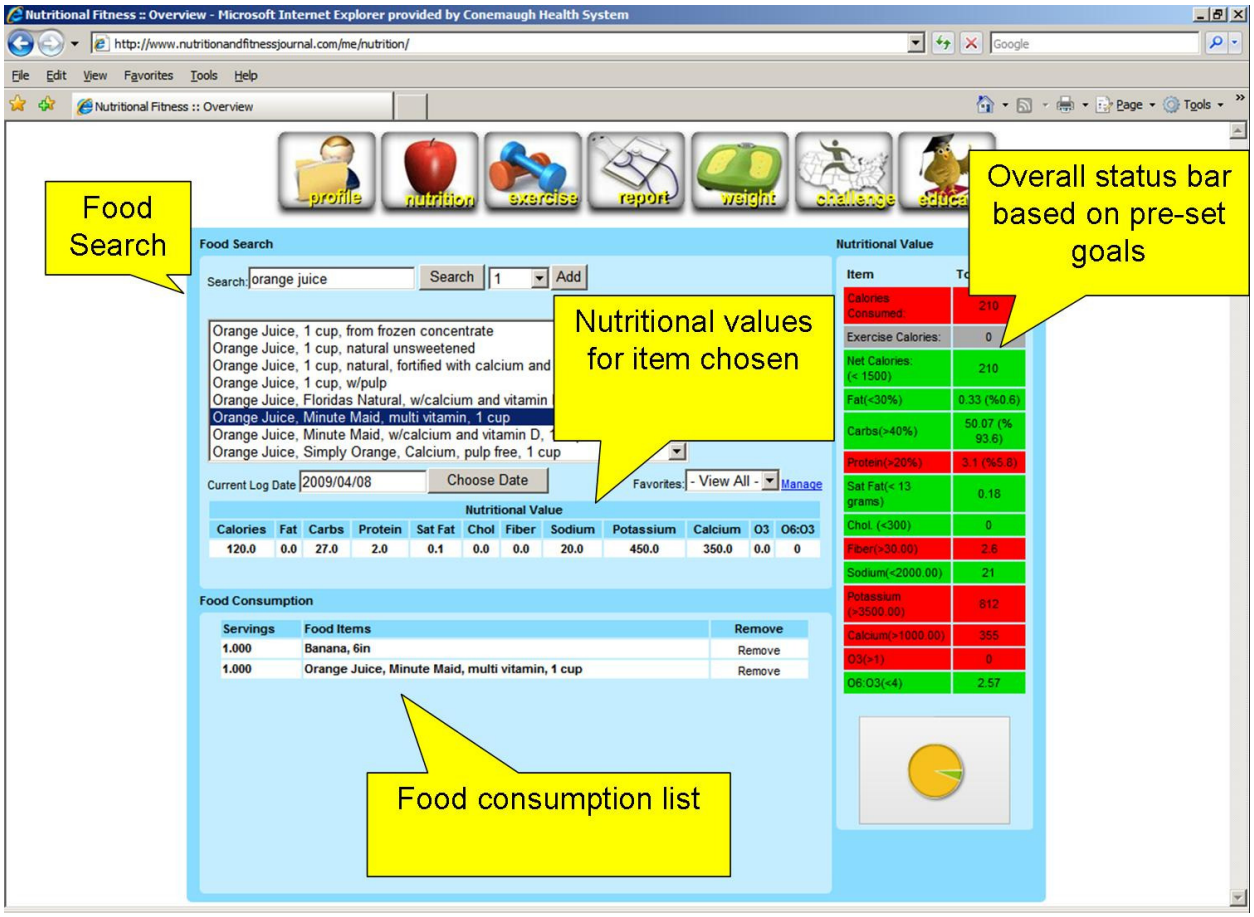
Nutrition and Fitness Journal

As stated in the research protocol, subjects were asked to enter their daily food consumption and exercise performed onto an internet-based diary located at www.nutritionandfitnessjournal.com. The technology was previously developed by Joe Shetler, an exercise physiologist, who regularly provides services to CHS on a consultant basis.

Research subjects agreed to utilize the website in the informed consent but study coordinators monitored their compliance through security logs. Subjects who were not compliant were contacted via email, telephone and postal mail at regular intervals.

Unlike traditional paper diaries, the journal processes that information and provides instant nutritional value (e.g. calories, carbs, fat) of the food consumed and number of calories burned for the respective exercise entries. Subjects were also provided with a real-time update of their current status based on pre-set weight and net caloric intake goals.

Figure 41 - Screenshot



Manuscript

The following manuscript describes the study in more detail and has been submitted for publication.

The Impact of Consumer Informatics in the Chronic Care Model:

Metabolic Syndrome in a Rural Setting

William Pruchnic, MD, Sharon Plank, MD, John Hargreaves, MBA,

Jeanette Croner, MHA, CCRC, Thomas Simunich, MBA, MS in MIS

Conemaugh Health System
1086 Franklin Street
Johnstown, PA 15905

Introduction

A recent study conducted by the National Center for Health Statistics suggests that 34% of U.S. adults meet the criteria for metabolic syndrome.[1] The prevalence study was based on information from the 2003-2006 National Health and Nutrition Examination Survey (NHANES). This growing epidemic has become an increased economic burden on society and action must occur now. People with metabolic syndrome are believed to be at an increased risk for cardiovascular disease and type two diabetes mellitus.[2] Metabolic syndrome was the selected patient population and is defined as a group of interrelated risk factors that if not properly managed by providers and patients may develop into a chronic disease and have a tremendous impact on healthcare costs. Risk factors used by the National Heart Lung and Blood Institute (NHLBI) for metabolic syndrome include: abdominal obesity, elevated blood pressure or hypertension, low High-density lipoprotein (good) cholesterol, elevated triglycerides, and elevated fasting glucose.[3] The condition is considered to be present when at least three of the above risk factors are present.

Evidence-based treatment of metabolic syndrome includes consumer empowerment, self management and lifestyle changes. In addition, our study was designed utilizing the conceptual framework of the Chronic Care Model[4], developed by Dr. Edward Wagner. Core components include: self-management support, delivery system design, decision support, clinical information systems and community partnerships.

Consumers living in rural areas typically do not have access to typical programs and treatment options, are forced to drive long distances to seek care and often miss significant time away from work. Innovative ways must be leveraged to slow down the growing diabetes and obesity epidemics in America. Several investigators have shown that consumer informatics tools (e.g. telemedicine) have been very effective in removing barriers to access for diabetes education[5-6] and psychiatry counseling[7] among others.

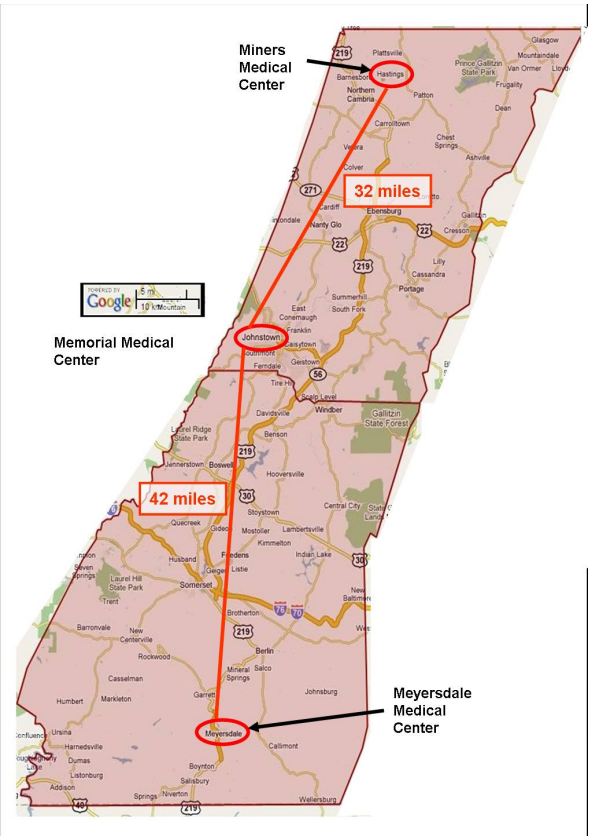
This study's primary objective was to examine the effectiveness of a 12-week Lifestyle Intervention Program delivered to two remote rural hospitals using a HIPAA compliant, 128-bit encryption video teleconferencing (VTC) system versus traditional, face-to-face counseling. Separate one hour sessions occurred twice a week at three hospitals within the Conemaugh Health System (CHS) in Southwestern Pennsylvania and were taught by two registered dietitians and an exercise physiologist under the supervision of the Principal Investigator. Previous research has shown that the combination of exercise and nutritional counseling has been the most effective in reducing risk factors for metabolic syndrome.[8]

A secondary objective of this study was to analyze the use and benefit of an Internet-based "Nutrition and Fitness Journal" previously developed by the exercise physiologist at CHS. Subjects were asked to enter their food consumption and exercise daily on an Internet-based journal. Unlike traditional paper diaries, the journal provides instant nutritional value (e.g. calories, carbohydrates, fat) of the food consumed and number of calories burned for the respective exercise performed. Subjects were also provided with a real-time update of their current "health status" based on pre-set weight and net caloric intake goals.

Methods

We conducted a clinical trial, as part of the Military Interoperable Digital Hospital Tested (MIDHT), initially involving 46 persons at 3 locations depicted in Figure 1 (CHS entities, including: Memorial Medical Center, Johnstown, PA; Miners Medical Center, Hastings, PA; Meyersdale Medical Center, Meyersdale, PA) who met the criteria published by NHLBI for metabolic syndrome. The research protocol received institutional review board (IRB) approval from Memorial Medical Center and the United States Army Medical Research and Materiel Command. Written informed consent was obtained from each enrolled subject prior to beginning research screening or interventions.

Figure 1. Study Locations



Participants

Eligibility criteria included: a blood pressure greater than or equal to 130/85, waist circumference greater than 35 inches (women) or 40 inches (men), triglycerides greater than or equal to 150 mg/dl, fasting blood glucose greater than or equal to 100 mg/dl, and HDL cholesterol greater than 50 mg/dl (women) or 40 mg/dl (men).[3] Additionally, the research team also included Body Mass Index (BMI) greater than or equal to 25, which has been suggested by the World Health Organization (WHO) as an additional criteria. Participants had to meet three of the above criteria or have a diagnosis of hypertension, which automatically qualified them for the study. Participants had to be 18 years of age or older and have daily access to the Internet. Eligible persons were excluded if they had a previous diagnosis of diabetes (self reported), were pregnant, or did not have access to the Internet (for completion of study requirements). Recruitment was designed to enroll 15 participants from a more urban area in Johnstown to participate face-to-face and 30 participants from rural areas (northern Cambria and southern Somerset counties) to participate in one of two offsite locations via VTC. When persons expressed interest in the study, they were mailed the informed consent to review, met with the study team to undergo the consent and screening process, and underwent physical and lab screenings to determine eligibility.

Interventions

Prior to beginning the Lifestyle Intervention Program, participants completed a readiness to change questionnaire. The questionnaire is based on the Transtheoretical Model (TTM), proposed by Prochaska and DiClemente in 1983. The model of behavior change has been used to create effective interventions that promote health behavior changes. TTM focuses on each individual's decision making and involves emotions, cognition, and behavior. The TTM describes basic Stages of Change in which individuals identify themselves based on their current status and readiness to change.[9]

Additionally, before beginning the Lifestyle Intervention Program, each participant created a unique username and password in order to use the online nutrition and fitness journal.

Participants were instructed how to log food consumed and exercise performed (see Figure 2). Subjects could ask the exercise physiologist questions regarding the website via email.

Eligible participants were assigned to either an On-Site or Off-Site cohort at one of three locations based on their physical proximity to the locations. On-site participants (n=15) attended classes at Memorial Medical Center and off-site participants (n=31) attended one of two rural medical centers, located 80 miles apart in SW Pennsylvania. On-site participants (n=8) and offsite participants (n=27) completed the 12-week Lifestyle Intervention Program. Participants received gift card incentives for attending classes and completing data collection requirements.

The intervention consisted of 24 group sessions completed over a 12-week time period, from September – November 2008. One class each week was taught by registered dietitians (Amanda Hoffman and Elena Gary) and focused on healthy diet and nutrition habits. The program, "NewView NewYou," was written and developed by the dietitians of the Conemaugh Diabetes Institute (CDI) for this study. The purpose of the program was to help participants reduce their risk of chronic disease through lifestyle changes and aimed to help individuals lose weight by eating healthier and increasing physical activity levels. A landmark research study, the Diabetes Prevention Program, found that a weight loss of at least 7% and 150 minutes per week of physical activity dramatically reduced the risk of developing type II diabetes.[10] The "NewView NewYou" program covered various topics to help participants achieve their healthy lifestyle goals, including: counting calories, reading the food label, fats, whole grains, sodium, Omega 3, calcium, healthy snacking, fruits and vegetables, dining out, healthy cooking, supermarket shopping and weight loss success strategies. Class sessions were presented in a fashion that is informational and interactive and included lecture, presentations, illustrations from educational websites and hands-on group activities.

The second session each week was a group fitness class taught by a certified exercise physiologist, Joe Shetler, who stressed the importance of cardiovascular exercise and strength training. Each participant was provided with SPRI (brand name) exercise tubes in different resistance levels. The participants brought their bands to class each week and participated in exercises led by the exercise physiologist.

Participants were encouraged to ask any questions or address any issues they may have been experiencing. The session began with a low impact warm-up, followed by strength training. All strength-training exercises utilized the exercise tubes and/or the participants' body weight so exercises could easily be replicated at home. At the conclusion of the strength training routine, a light stretch was performed and weekly assignments were given, to encourage each participant to engage in activity outside of the classroom setting. The participants were urged to complete at least two to three additional days of strength training per week and at least five additional days of cardiovascular exercise. Each participant was instructed to log each exercise session in his or her nutrition and fitness journal. By completing these weekly assignments, participants were able to instantly see how their exercise sessions were impacting their net caloric intake for each day.

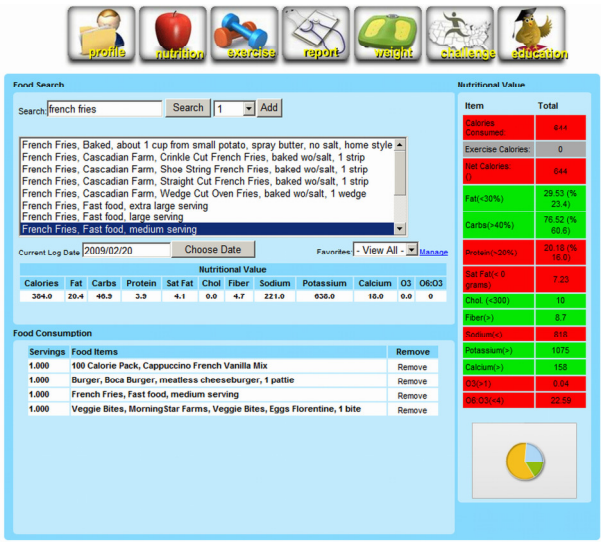


Figure 2: Nutrition & Fitness Journal

Outcome Measures

The primary hypothesis of our study was that there is no difference in the functionality, usability, and benefits of the educational sessions offered in person as compared to those offered remotely via VTC. Hypothesis testing was measured based on changes in health outcomes using BMI, blood pressure, weight, waist circumference, body fat, hemoglobin A1c, fasting glucose, triglycerides and HDL cholesterol.

Physical measurements and labs were assessed at three time points during the study:

1. baseline (pre-intervention)
2. 12 weeks (end of the intervention, "Post")
3. 52 weeks (1 year from baseline, "Final")

All lab tests were performed after a 12-hour fast at one of the three study sites. Each participant had all three sets of labs drawn and processed at the same location for each time point. Additional measurements included class attendance, online journal usage, and responses of participant completed questionnaires designed to assess their evaluation of the VTC technology and online journal. The questionnaires were developed by the study team and adapted from a study conducted at the University of Pittsburgh which assessed the usability and functionality of the telehealth technologies used in this intervention.[11] The On-Site and Off-Site questionnaires asked participants to answer questions related to their learning experience, and to describe their perceptions of the benefits and/or drawbacks to the Lifestyle Intervention Program offered via VTC. Changes in medications were collected but did not warrant further analysis.

Results

Relative to each other, the cohorts were homogeneous on gender and age. The cohorts were also analyzed pair-wise at two different time-point pairs, Post vs. Baseline and Final vs. Baseline. The cohorts were not statistically different (alpha=0.05, 2-tailed) on the majority of outcome measures for either time-point pair. Overall, greater clinical improvement existed at the Post-Baseline time-point relative to that of the Final-Baseline. Furthermore, at least 50% of all subjects improved on 80% of the outcome measures for both time-point pairs. Finally, the majority of subjects demonstrated greater improvement on the physical outcome measures relative to the laboratory values. Unfortunately, the disparity of sample size and additionally the small sample size of the On-Site cohort limited both the applicable statistical tests and the degree and confidence to which the subsequent inferences and interpretations can be drawn.

Attempting to increase the confidence of the interpretations drawn from the analysis of the On-Site versus the Off-Site groups, the research team analyzed data from the Conemaugh Diabetes Institute's Lifestyle Balance program (2006-2007), which delivered similar information in a similar way by the same clinicians to non-diabetics as that received by the On-Site cohort. That program (n=44) recorded weight, waist circumference, BMI, BP-systolic, and BP-diastolic. The results of a Wilcoxon-Mann-Whitney test between that data and the present on-site cohort suggest that there is no statistically significant difference between the underlying distributions on weight, BMI, BP-systolic, and BP-diastolic. Therefore, the researchers have more confidence that even though the sample size of the on-site cohort is extremely small, it does follow the distribution that would be expected. Next, the results of a Wilcoxon-Mann-Whitney test between the change of the outcome measures (post-baseline) of the on-site and off-sites cohorts suggest that there is no statistically significant difference between the underlying distributions of the cohorts on weight, BMI, body fat, glucose, and triglycerides. These conclusions match those obtained from an ANOVA analysis. Even though the data does deviate from normality, the fact that the conclusions drawn from the nonparametric test and its parametric analogue match exactly provide compelling evidence that the deviation is within the limits of robustness of an ANOVA (and paired-t test).

Additionally, the results of Levene's test for homogeneity of variances do not indicate heterogeneity of variance between cohorts for any change in outcome measure except HDL. Therefore the hypothesis can be accepted that there is no difference between the cohorts on the outcome measures of weight, BMI, body fat, glucose, and triglycerides. The results of a paired-t test (post minus baseline) reveal that the change is significant for the Off-Site cohort for weight, waist circumference, BMI, and HA1c. Although this result differs from the On-Site group, the important point is that the Off-Site cohort did improve more than the On-Site cohort and that improvement was statistically significant for many of the outcome measures.

Table 1: Paired Samples Test

	Outcome Measure Pair (Post-Base)		Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Off-Site	Pair 1	Post_Weight_lbs - Base_Weight_lbs	-9.02	6.89	1.33	-11.74	-6.29	-6.80	26	0
	Pair 2	Post_Waist_Circumference_inches - Base_Waist_Circumference_inches	-3.02	1.87	0.36	-3.76	-2.28	-8.39	26	0
	Pair 3	Post_BMI - Base_BMI	-1.47	1.21	0.23	-1.95	-0.99	-6.31	26	0
	Pair 4	Post_BP_systolic - Base_BP_systolic	-2.30	13.17	2.53	-7.51	2.91	-0.91	26	0.37
	Pair 5	Post_BP_diastolic - Base_BP_diastolic	-2.48	6.64	1.28	-5.11	0.14	-1.94	26	0.06
	Pair 6	Post_Body_Fat_dec_percent - Base_Body_Fat_dec_percent	-0.011	0.022	0.0043	-0.0202	-0.0025	-2.64	26	0.01
	Pair 7	Post_Glucose - Base_Glucose	-0.19	8.79	1.69	-3.66	3.29	-0.11	26	0.91
	Pair 8	Post_HA1c_dec_percent - Base_HA1c_decimal_percent	-0.0022	0.0039	0.0008	-0.0038	-0.0007	-2.96	26	0.01
	Pair 9	Post_Triglycerides - Base_Triglycerides	5.41	43.63	8.40	-11.85	22.67	0.64	26	0.53
	Pair 10	Post_HDL - Base_HDL	-1.59	7.40	1.43	-4.52	1.34	-1.12	26	0.27
On-Site	Pair 1	Post_Weight_lbs - Base_Weight_lbs	-9.10	16.16	5.71	-22.61	4.41	-1.59	7	0.16
	Pair 2	Post_Waist_Circumference_inches - Base_Waist_Circumference_inches	-1.03	1.86	0.66	-2.58	0.53	-1.56	7	0.16
	Pair 3	Post_BMI - Base_BMI	-1.33	2.24	0.79	-3.19	0.54	-1.68	7	0.14
	Pair 4	Post_BP_systolic - Base_BP_systolic	-12.75	11.04	3.90	-21.98	-3.52	-3.27	7	0.01
	Pair 5	Post_BP_diastolic - Base_BP_diastolic	-9.38	8.47	2.99	-16.45	-2.30	-3.13	7	0.02
	Pair 6	Post_Body_Fat_dec_percent - Base_Body_Fat_dec_percent	-0.0081	0.0221	0.0078	-0.0266	0.0103	-1.04	7	0.33
	Pair 7	Post_Glucose - Base_Glucose	-0.25	12.02	4.25	-10.30	9.80	-0.06	7	0.96
	Pair 8	Post_HA1c_dec_percent - Base_HA1c_decimal_percent	0.0016	0.0038	0.0013	-0.0016	0.0048	1.21	7	0.27
	Pair 9	Post_Triglycerides - Base_Triglycerides	-27.00	38.86	13.74	-59.49	5.49	-1.97	7	0.09
	Pair 10	Post_HDL - Base_HDL	2.38	3.20	1.13	-0.30	5.05	2.10	7	0.07

Table 2:

Outcome Measure (o.m.)	Average Change per Outcome Measure, (Final - Baseline)			% of All Subjects that improved on the indicated o.m.
	ON-Site Only	OFF-Sites Only	ALL Subjects	
Weight, lbs	-10.6	-5.5	-6.5	68%
Waist Circumference, inches	-0.9	-0.8	-0.8	55%
Body Fat, decimal_percent	-0.020	-0.009	-0.011	55%
Body Mass Index (BMI), kg/m^2	-1.6	-0.7	-0.9	68%
Blood Pressure, (systolic), mmHG	-7	-5	-6	58%
Blood Pressure, (diastolic), mmHG	-4	-3	-3	61%
Triglycerides, mg/dL	51	6	15	39%
HDL, mg/dL	6	-1	1	55%
Glucose, mg/dL	-3.5	-0.4	-1.0	65%
HA1c, %	0.4%	-0.01%	0.1%	45%

Table 3:

Outcome Measure (o.m.)	Average Change per Outcome Measure, (Post - Baseline)			% of All Subjects that improved on the indicated o.m.
	ON-Site Only	OFF-Sites Only	ALL Subjects	
Weight, lbs	-9.1	-9.0	-9.0	89%
Waist Circumference, inches	-1.0	-3.0	-2.6	91%
Body Fat, decimal_percent	-0.008	-0.011	-0.011	66%
Body Mass Index (BMI), kg/m^2	-1.3	-1.5	-1.4	86%
Blood Pressure, (systolic), mmHG	-13	-2	-5	63%
Blood Pressure, (diastolic), mmHG	-9	-2	-4	66%
Triglycerides, mg/dL	-27	5	-2	54%
HDL, mg/dL	2	-2	-1	46%
Glucose, mg/dL	-0.3	-0.2	-0.2	40%
HA1c, %	0.2%	-0.2%	-0.1%	57%

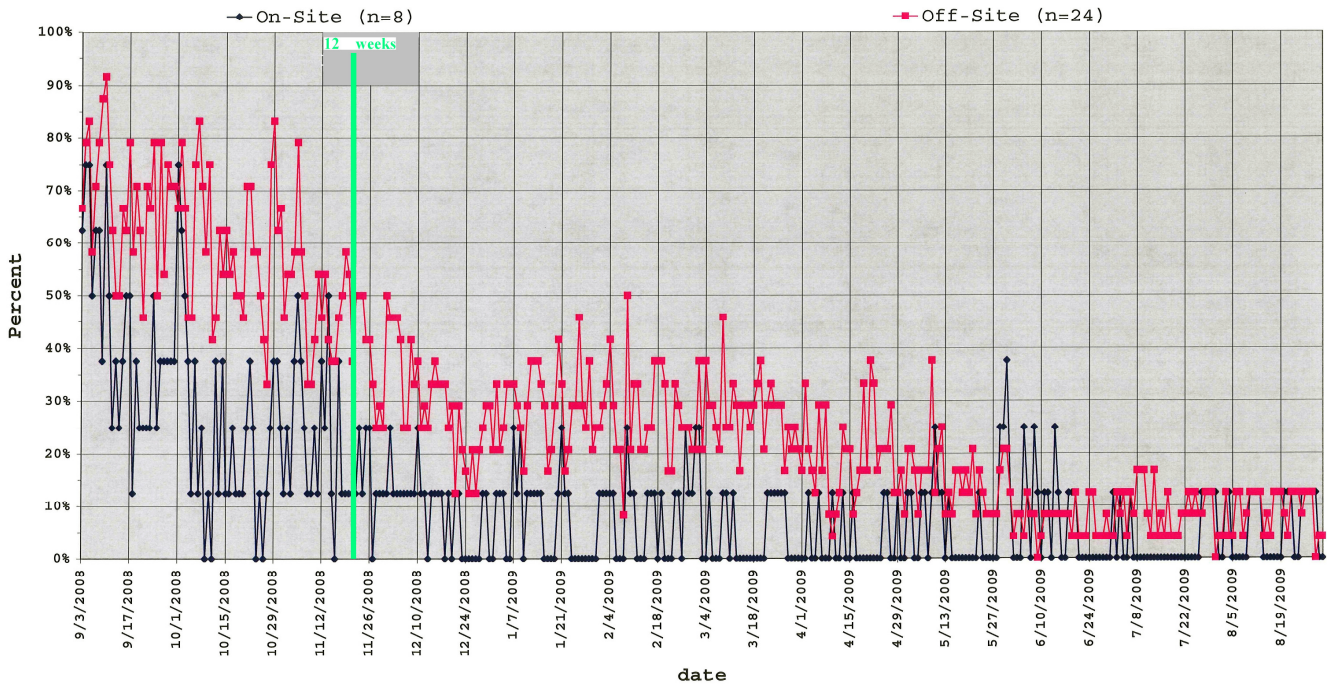
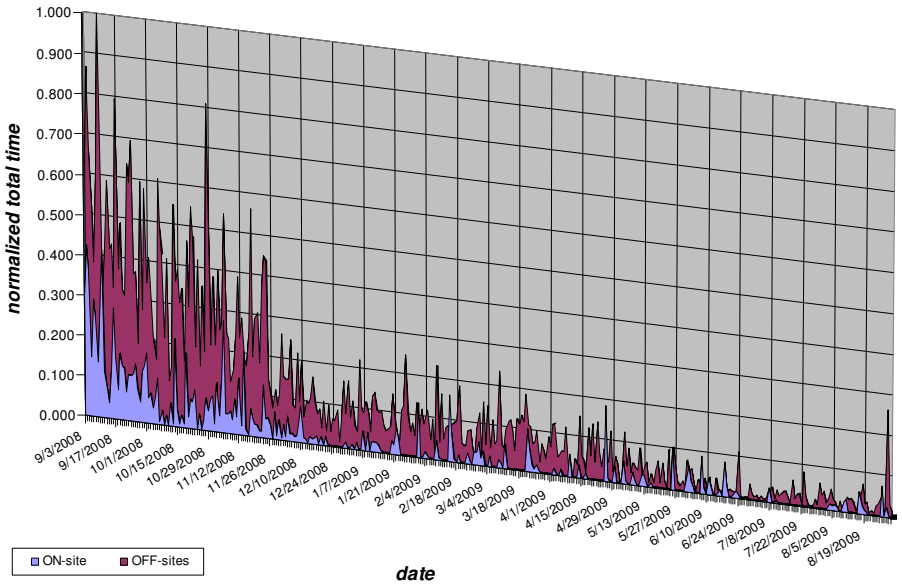


Figure 3: Journal Usage

Figure 3 demonstrates a definite decreasing usage trend for both cohorts over time. No statistical difference was found in the trends between cohorts. The data does support the interpretation that the difference in the average of 'usage' is significant between the intervention and post-intervention periods – particularly for the Off-Site cohort. The same trend was observed when journal usage was quantified by total time used (in ten minute periods or less, see Figure 4), number of clicks on the nutrition page, and number of clicks on the exercise page. Multiple correlation analyses between the outcome measures collected at the post and final time periods and journal usage were performed per cohort. Although (2-tailed) significance was not found, the results did show a strong degree of correlation near an alpha=0.12 for some outcome measures. The lack of statistically significant correlations is most probably the result of the small sample size and the greater than three multiple difference between cohort size.



Discussion

Reimbursement of telemedicine in the United States has been slow and is currently inconsistent among many states and insurers. Approximately thirty states have acknowledged some reimbursement for telemedicine and the state of Pennsylvania may want to consider the same.[12] Local stakeholders should consider supporting HB 99 (2009 Session), which would require all health insurers in Pennsylvania to provide coverage for telehealth if a health care professional certifies that certain conditions are met. The bill is pending in the legislature and would spur broader based telemedicine initiatives in the state.

Our study has proven, despite its limitations, that chronic disease prevention via VTC technology was equally as effective as traditional, face-to-face counseling. Telemedicine can be most effective in rural areas, where patients can gain access to specialized medical education and services through technology. If done properly, it may spur a reduction in healthcare costs through better health outcomes, fewer patient absences from work associated with traveling long distances to seek care, and improved reach to a larger group of patients resulting in operating efficiencies. Our study provided services over a 74 - mile area (two counties) in SW Pennsylvania in which 77 % of subjects primarily resided in rural areas. Telemedicine initiatives are well suited in our state since Pennsylvania has one of the largest rural populations in the U.S.

Furthermore, residents in rural areas are more likely to report fair to poor health conditions than urban residents (19.5% vs. 15.6%) and are more likely to be diabetic, obese[13] and have heart disease.[14]

Participating providers felt more comfortable using the technology as the program progressed and all would participate in future initiatives using video teleconferencing. There was a small learning curve associated with the program as providers were not accustomed to teaching a group in person and two groups at a distant simultaneously. Finally, future VTC implementations should note the importance of room setup in order to foster a productive learning environment for both providers and patients alike.

One limitation of the study was the small sample size (n=6) of the On-Site cohort. The small sample size severely limited the choice of statistical tests that could be applied to the dataset. Furthermore, since n<10, the results of many of the statistical tests, particularly regarding the cohort comparisons, must be interpreted with caution.

A second limitation of the study was that multiple clinicians participated in the subject data collection process. There may have been differences in the way that blood pressure and/or waist circumference were measured. This issue was partially mitigated by attempting to keep the same clinical staff with each cohort. Weight, BMI and body fat were consistently measured for all subjects using a Tanita Body Composition Analyzer, TBF-300A.

A third limitation of the study was that the Nutrition & Fitness Journal was not working properly on Microsoft's Internet Explorer until January 2009, four months after the study's start date. The journal was available on other browsers (e.g. FireFox) but this issue may have affected subject adoption and usage in the beginning months.

A fourth limitation of our study was the disproportionate share of females vs. males. Although both cohorts were homogenous in nature, only 11% of total subjects were males. On a positive note, many subjects were baby boomers with average age of 55 years old.

Future studies should seek to enroll more subjects and significantly decrease the difference between the sample sizes of the cohorts. Special attention should also be focused on retaining subjects to help ensure equivalent sample size at

the various time points. Finally, a study design which enables and encourages frequent subject-instructor and within-cohort subject-subject interaction during the "follow-up" phase should be earnestly considered.

Conclusion

The results of our study support acceptance of the hypothesis that there would be no significant difference in outcome measures between the On-Site (i.e. face-to-face) and Off-Site (i.e. VTC) groups. Additionally, patients residing in the rural areas were more active and interested as measured by attendance, drop-out rate and journal usage. Healthcare organizations should consider implementing VTC in order to provide expanded services and programs to rural America. When comparing study results from post intervention (12-weeks) and final (one year), it is quite clear that patients need frequent interaction and accountability with providers and colleagues to achieve the best health outcomes possible. Aside from quantitative analysis, this argument is supported by survey comments and personal discussions.

Patient usage and resulting written feedback of internet technologies were mixed, which presented much difficulty in determining the true impact of the technical issues associated with the website and dial-up Internet access on journal usage. A majority of patients (92%) in the Off-Site cohort would participate in more programs via VTC and believe they would not have been able to participate without the technology.

Acknowledgements

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Author Disclosure Statement

No competing financial interests exist.

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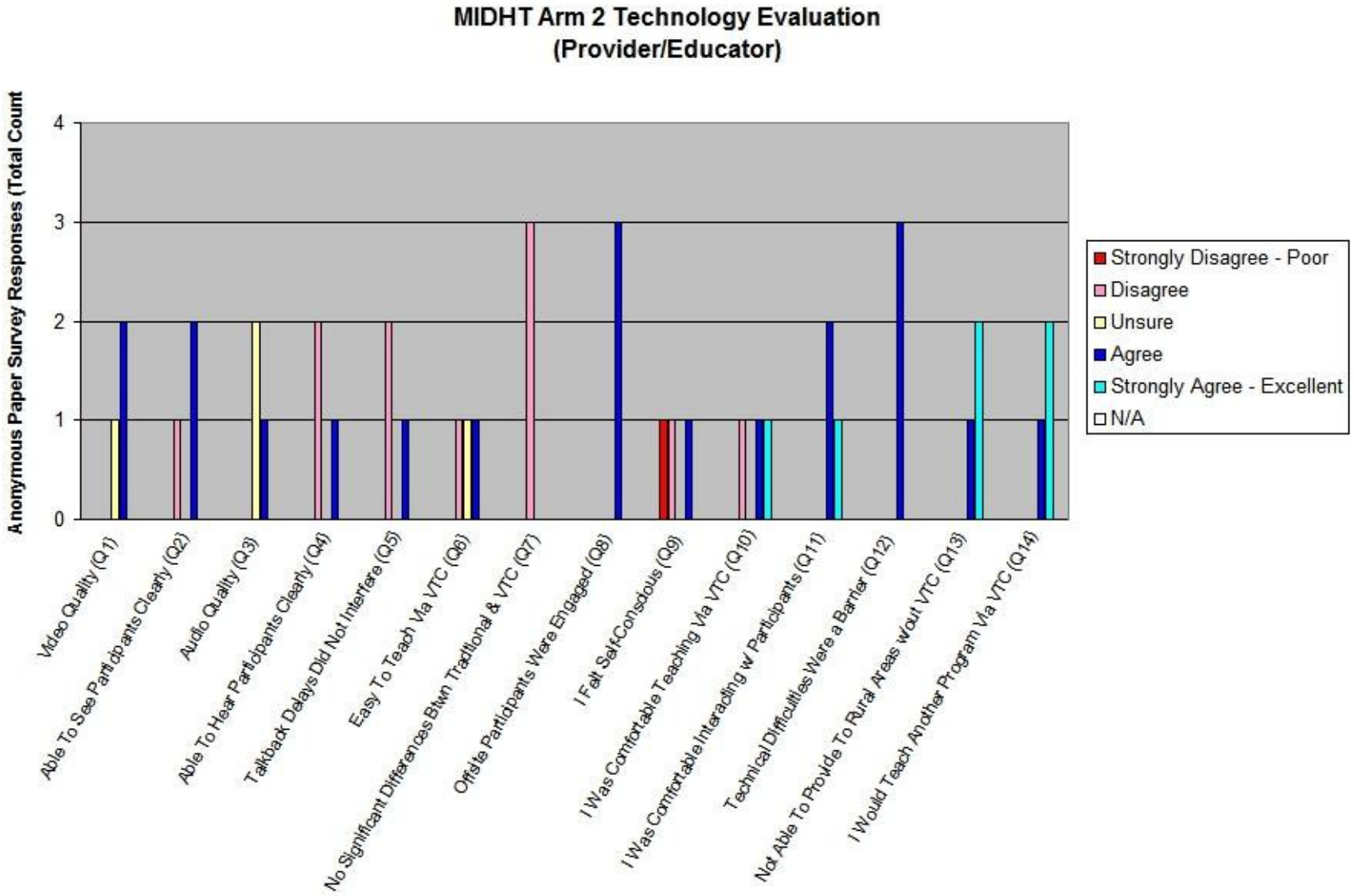
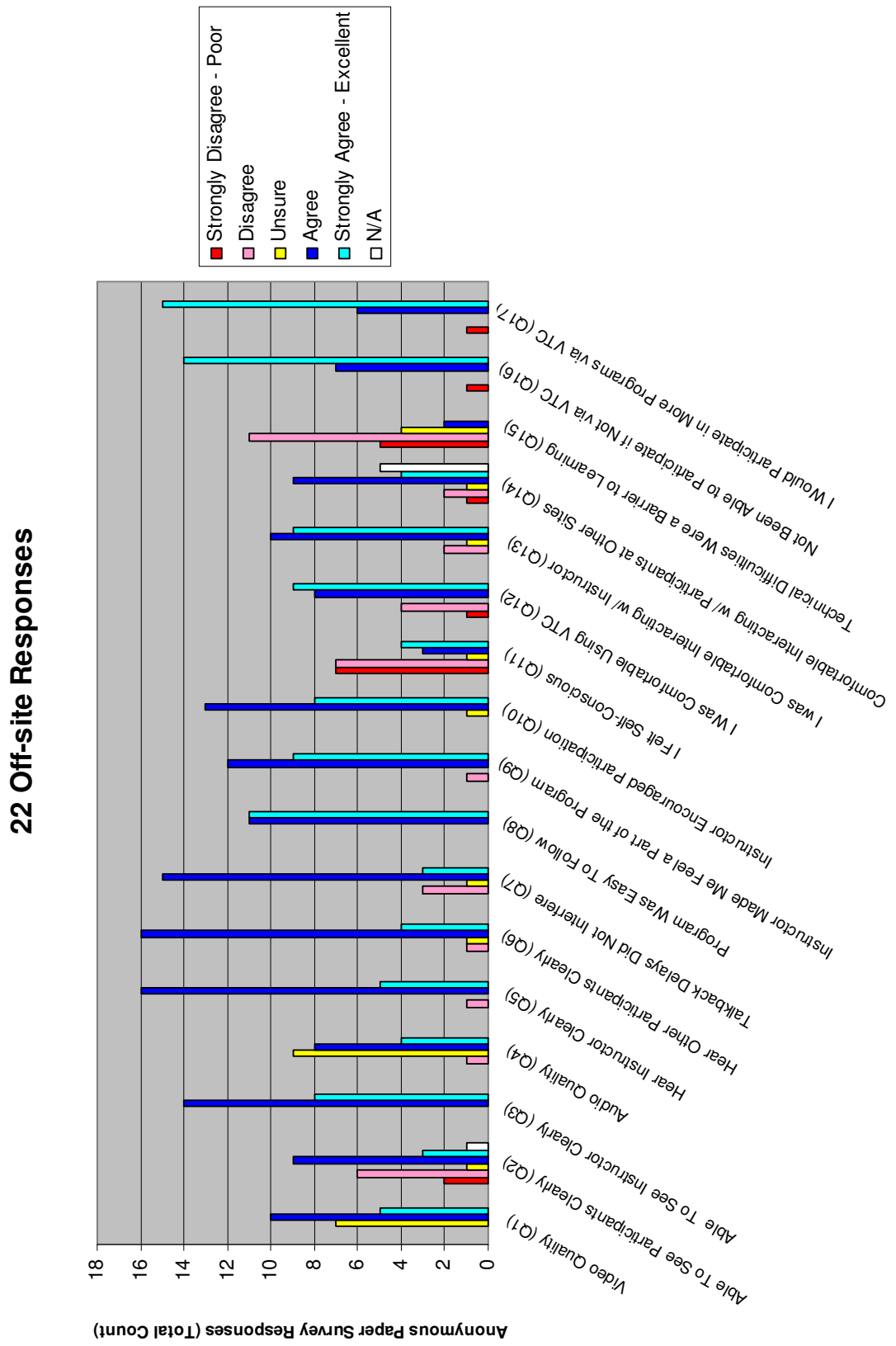
Video Teleconferencing Surveys

The following graphs were produced from anonymous paper survey responses that evaluated the use of video teleconferencing used during the Lifestyle Intervention Program. The following stakeholders provided information:

- Providers (Exercise Physiologist & Registered Dietitians)
- On-Site Cohort (Johnstown)
- Off-Site Cohort (Miners & Meyersdale)

In general, the program was well received by research subjects at all three locations and there was overwhelming support for the effectiveness of VTC for community outreach initiatives. Ninety three percent (93%) of subjects would participate in future programs via VTC by selecting “Strongly Agree” or “Agree.”


MIDHT Arm 2 Technology Evaluation
(Provider/Educator)
Anonymous Paper Survey Responses (Total Count
0
1
2
3
4
Video Quality (Q1)
Able To See Participants Clearly (Q2)
Audio Quality (Q3)
Able To Hear Participants Clearly (Q4)
Talkback Delays Did Not Interfere (Q5)
Easy To Teach Via VTC (Q6)
No Significant Differences Btwn Traditional & VTC (Q7)
Offsite Participants Were Engaged (Q8)
I Felt Self-Conscious (Q9)
I Was Comfortable Teaching Via VTC (Q10)
I Was Comfortable Interacting w/ Participants (Q11)
Technical Difficulties Were a Barrier (Q12)
Not Able To Provide To Rural Areas w/out VTC (Q13)
I Would Teach Another Program Via VTC (Q14)
Strongly Disagree - Poor
Disagree
Unsure
Agree
Strongly Agree - Excellent
N/A


22 Off-site Responses
Strongly Disagree - Poor
Disagree
Unsure
Agree
Strongly Agree - Excellent
N/A
Anonymous Paper Survey Responses (Total Count)
0
2
4
6
8
10
12
14
16
18
Video Quality (Q1)
Able To See Participants Clearly (Q2)
Able To See Instructor Clearly (Q3)
Audio Quality (Q4)
Hear Instructor Clearly (Q5)
Hear Other Participants Clearly (Q6)
Talkback Delays Did Not Interfere (Q7)
Program Was Easy To Follow (Q8)
Instructor Made Me Feel a Part of the Program (Q9)
Instructor Encouraged Participation (Q10)
I Felt Self-Conscious (Q11)
I Was Comfortable Using VTC (Q12)
I was Comfortable Interacting w/ Instructor (Q13)
I was Comfortable Interacting w/ Participants at Other Sites (Q14)
Technical Difficulties Were a Barrier to Learning (Q15)
Not Been Able to Participate if Not via VTC (Q16)
I Would Participate in More Programs via VTC (Q17)

Return on Investment (ROI) Analysis

A Return on Investment analysis was completed on the following situation: deliver medical nutrition and exercise counseling to patients at risk for chronic disease using video teleconferencing (VTC) for three (3) twelve-week sessions to three medical sites simultaneously. A three-year ROI model was used in order to predict a net present value, return on investment and payback in years for the given situation.

Operating Costs assumptions:

- VTC Equipment
  - Three HDX 8002 XL Polycom systems that support content sharing, multipoint access and two cameras for each location
- System Maintenance
  - 1 year premier coverage, HDX 8000 Series
  - Includes 4.17% inflation (2008 average) in Years 2 & 3
- Wide Area Network
  - Monthly business class broadband – appropriate bandwidth for HD VTC
  - Firewall appliances for intersite communication
  - Cabling
  - UPS Battery Backup
- Installation
  - 40 hours, $125/hr
- Staffing
  - Registered Dietitian, $21/hour, 72 hours
  - Exercise Physiologist, $25/hour, 72 hours
  - Technical Support, $19/hour, 18 hours
  - Includes 20% overhead
  - Includes 4.17% (2008 average) inflation in Years 2 & 3
- Facility Cost
  - 1,000 SF, $12/SF, 1% usage, 3 locations

Program Reimbursement assumptions:

- 36 weekly sessions (12-week program)
- Two classes per week, 60 minutes duration each
- 50 patients per program; 20 On-site, 30 Off-sites
- Realized reimbursement per patient = $16
  ($26 charge – based on current charge of group medical nutrition therapy (CPT Code 97804), 60% realized)
- Telehealth Originating Site Facility Fee Payment (2007) (lesser of $22.94 or actual charge)
- State of Pennsylvania to approve reimbursement of telemedicine activities
- CMS approves exercise physiologist as an eligible telehealth provider
- CMS approves exercise counseling for medical purposes, assigns CPT code
- CMS extends approved duration per patient from 3 hours to 12 hours per year
- Implementation Filter – 67% Year 1, 90% Year 2, 95% Year 3
- Reduction in travel expenses to other two sites (traditional method)
- Reduction in staffing expenses due to absence of travel, includes 20% overhead (traditional method

Conemaugh Health System
Return-on-Investment (ROI) Analysis
MIDHT Arm 2

Data cell key
User data entry or item description
Formula cells: Totals are calculated and filled in automatically.

Investment overview
Project name: Chronic Disease Prevention via Telemedicine
General description of benefits: Deliver medical nutrition and exercise counseling to patients at risk for chronic disease using video teleconferencing (VTC) for twelve-week sessions to three sites simultaneously

Cash flow and ROI statement

BENEFIT DRIVERS	Amount	**YEAR** 0	1	2	3
Program Reimbursement			**$58,288**	**$58,288**	**$58,288**
* # of weeks, (12-week programs)	36				
* Classes per week - 60 minutes	2				
* # of patients per program	50				
* Realized reimbursement per patient ($26 charge)	$16				
* Telehealth Originating Site Facility Fee Payment (lesser of $22.94 or actual charge)	$22.94				
Reduction in travel costs to other two locations			**$1,039**	**$1,039**	**$1,039**
Reduction in staff costs due to travel time (includes 20% overhead)			**$3,974**	**$3,974**	**$3,974**
Total annual benefits			*$63,302*	*$63,302*	*$63,302*
Implementation filter			**67%**	**90%**	**95%**
Total benefits realized			*$42,412*	*$56,971*	*$60,137*
Costs		**Year 0**	**Year 1**	**Year 2**	**Year 3**
Total		*$57,249*	*$17,075*	*$14,068*	*$14,373*
Benefits		**Year 0**	**Year 1**	**Year 2**	**Year 3**
Annual benefit flow		*($57,249)*	*$25,337*	*$42,904*	*$45,764*
Cumulative benefit flow		*(57,249)*	*(31,912)*	*10,992*	*56,756*
Discounted Benefit Flow		**Year 0**	**Year 1**	**Year 2**	**Year 3**

Discounted costs		*$57,249*	*$14,848*	*$10,637*	*$9,450*
Discounted benefits		*0*	*36,880*	*43,079*	*39,541*
Total discounted benefit flow		*(57,249)*	*22,032*	*32,441*	*30,090*
Total cumulative discounted benefit flow		*(57,249)*	*(35,217)*	*(2,775)*	*27,315*
Initial Investment		**Year 0**	**Year 1**	**Year 2**	**Year 3**
VTC Equipment (includes 3 HD systems, multipoint access, and support for content sharing/two cameras each location)		**$52,249**	**$0**	**$0**	**$0**
Implementation Costs		**$5,000**	**$0**	**$0**	**$0**
Maintenance Costs			**$2,640**	**$2,750**	**$2,865**
Network Costs			**$6,810**	**$3,510**	**$3,510**
Personnel Costs (includes 20% overhead) * excludes program development	20%				
	4.17%				
* Registered Dietitian	$21.00		**$1,814**	**$1,890**	**$1,969**
* Exercise Physiologist	$25.00		**$2,160**	**$2,250**	**$2,344**
* Technical Support	$19.00		**$410**	**$428**	**$445**
Facility Cost			**$3,240**	**$3,240**	**$3,240**
* Square Footage	1000				
* Price/SF	$12.00				
* Annual Usage	1%				
* # of locations	3				
* Months in use	9				
Total costs		*$57,249*	*$17,075*	*$14,068*	*$14,373*
ROI measures					
Cost of capital		**15%**			
Net present value		*$27,315*			
Return on investment			*51%*	*97%*	*130%*
Payback (in years)		*1.74*			

Summary

As the ROI model states above, the following ROI measures were calculated:

Net Present Value = $27,315; the sum of the discounted values of future cash flows less the initial investment.

Return on Investment =

Year 1	Year 2	Year 3
51%	97%	130%

Payback (in years) = 1.74; number of years to recoup your investment

The initial VTC equipment and installation investment (assumes 15% financing rate) will be paid back in one year and nine months given the cost and reimbursement assumptions. The implementation filter is important to note as organizations that are unfamiliar with video teleconferencing and telemedicine will have some growing pains in the first year, which we experienced in our study. The staffing costs are actual instruction only and do not include program development time. The return on investment will be very close to 100% after just two years, suggesting that it would be a wise decision for a health care organization to invest in a video teleconferencing initiative for telemedicine purposes. Our study suggests that chronic disease prevention counseling through VTC (Off-Site Cohort) was just as effective as face-to-face instruction (On-Site Cohort).

Reimbursement of telemedicine in the United States has been slow and is currently inconsistent among states and insurers. Approximately thirty states have acknowledged some reimbursement for telemedicine and the state of Pennsylvania should seriously consider the same. Local stakeholders should support HB 99 (2009 Session), which would require all health insurers in Pennsylvania to provide coverage for telehealth if a health care professional certifies that certain conditions are met. The bill is pending in the legislature and is opposed by Highmark, a large insurance company.

Telemedicine can be most effective in rural areas, where patients can gain access to specialized medical education and services through technology, reducing costs and missed time from work associated with traveling long distances and improving health outcomes. Medicare should consider adding CPT Code 97804 (Medical Nutrition Therapy (MNT), group) to the approved list, adding exercise physiologist to the eligible provider list and extending the MNT counseling duration from three to 12 hours annually per patient.

Reportable Outcomes

Arm 1

- EMR Evaluation Report
- HIE service-based infrastructure (Conemaugh specific)
- HIE pilot portal provided by NG/Covisint (Conemaugh – Department of Defense) and respective technical documentation
- Baseline productivity and provider workflow before EHR implementation at two sites
- Baseline Attitudes, Perceptions and Readiness for Health Information Technology (HIT)

Arm 2

- Pruchnic W, Plank S, Hargreaves J, Croner J, Simunich T. The Impact of Consumer Informatics in the Chronic Care Model: Metabolic Syndrome in a Rural Setting. (*submitted for publication*)

Arm 3

- Hargreaves J. Will Electronic Personal Health Records Benefit Providers and Patients in Rural America? *Telemedicine and e-Health.* March 2010.

Conclusion

The health information exchange infrastructure was successfully implemented over the course of the project within the rural confines of the Conemaugh Health System. This milestone has significantly enhanced the digitization of medical records, both acute and ambulatory, and therefore the electronic sharing of medical information between providers located at Memorial Medical Center, Miners Medical Center, Meyersdale Medical Center, Portage Health Center and NORCAM Community Health Center. The implementation of the Allscripts electronic health record provided many challenges to the technical and functional teams. Qualitative and quantitative analyses will be performed in Phase II to evaluate the change in productivity and satisfaction.

The health information exchange portal designed and implemented during this respective contract by Northrop Grumman IT for external data sharing has since been realigned by TATRC with the Military Health System IM/IT Strategic Plan (2010-2015) and away from point to point, customized connections. Future phases of the MIDHT project will utilize the open source Nationwide Health Information Network (NHIN) CONNECT architecture for data exchange between Conemaugh Health System and the Department of Defense.

The results of our Arm 2 study support acceptance of the hypothesis that there would be no significant difference in outcome measures between the On-Site (i.e. face-to-face) and Off-Site (i.e. VTC) groups. Additionally, patients residing in the rural areas were more active and interested as measured by attendance, drop-out rate and journal usage. Healthcare organizations should consider implementing VTC in order to provide expanded services and programs to rural America.

When comparing study results from post intervention (12-weeks) and final (one year), it is quite clear that patients need frequent interaction and accountability with providers and colleagues to achieve the best health outcomes possible. Aside from quantitative analysis, this argument is supported by survey comments and personal discussions.

Patient usage and resulting written feedback of internet technologies was mixed, which presented much difficulty in determining the true impact of the technical issues associated with the website and dial-up Internet access on journal usage. A majority of patients (92%) in the Off-Site cohort would participate in more programs via VTC and believe they would not have been able to participate without the technology.

Lessons Learned

Allscripts Touchworks EHR 4-month Delay:

Root Cause

The delay was caused by problems encountered in integrating a trusted third-party "Enterprise ID" (EID) into the data flow. Initial project design established support for an EID within the Allscripts Touchworks system. However, Conemaugh's project team encountered many problems and re-starts as it conducted unit testing and full-scale bulk-load testing of the integration. We worked closely with Allscripts software engineers and project team personnel for many weeks to design, test, and debug multiple integration configurations. These steps took months to work through and resulted in a delay of the scheduled LIVE status.

Background

There are many EHR rollouts occurring across the country where each physician office EHR installation creates its own patient database. Most often, these EHR installations obtain their patient ID from the practice management system that interfaces registration and scheduling information to the EHR. While much easier to install, this approach creates many islands of patient data. The fact that there is no Universal Patient Identification number in place creates significant challenges in information sharing. Information sharing on a limited, situational basis via a RHIO or HIE environment can work between health systems, but it is not the desired approach within a single health system for many self-evident reasons.

From the onset, Conemaugh's project team has held fast to our vision of a single clinical record for each patient in our Allscripts Touchworks EHR. The physicians who practice within the Conemaugh Health System expect a seamless way to access and update a unified patient record. This is similar to how they interact with a single patient record within the acute care hospital environment. The benefits of one record are many:

- integrated medication history
- provider to provider communication (primary care to specialist)
- hospitalist information access
- Emergency Department communications
- Patient safety (lessened chance of outdated data)

Approach

As is the case in many environments, Conemaugh has multiple practice management systems that will interact with our EHR and each of these applications has its own patient identification number and system. Our solution has been to implement an Enterprise Master Patient Index system (EMPI). The role of the EMPI is to:

- accept feeds from multiple source systems

- maintain a single "person" database of unique human beings by applying sophisticated matching algorithms
- assign an Enterprise ID number (EID)
- cross match all source ID numbers to the EID that it manages
- respond to HL7 and web service requests to provide any number source number based on any other source number
- serve as the "Source of Truth" for all cases in which a patient record is to be linked between systems

Initiate EMPI

As part of MIDHT project, Conemaugh evaluated various EMPI vendors and ultimately selected Initiate as the vendor of choice and installed their EMPI application. The Initiate EMPI went live in June of 2008. As of today, we have 5 different data sources interfacing patient information into the Initiate EMPI. These are:

Memorial Medical Center (hospital)
Miners Medical Center (hospital)
Meyersdale Medical Center (hospital)
Conemaugh Health Initiatives CHI database (physician office)
Conemaugh Health Initiatives RHC database (physician office)

Each of the 5 sources listed above maintains its own master patient index system, but the Initiate EMPI links them all together and assigns its own EID.

Impact on Allscripts Touchworks EHR (what went wrong)

Our plan was to pass the EID to Allscripts and have it serve as the "source of truth" for all patient records in the Touchworks EHR. What we learned in our testing is that Touchworks performs its own patient matching and it assigns its own internal EID. In its current version, it is not capable of accepting a third-party EID as its internal ID number. In effect, we have 2 applications doing the same thing. It is understandable why Allscripts would build patient matching logic into its system - most environments do not have an EID in place like we have here at Conemaugh. What has frustrated our project team is the fact that the Initiate EMPI has far superior logic in place than the simplistic patient matching logic that Allscripts possesses and that it would work much better in our environment to accept the Initiate-assigned EID in all cases.

Solution

In the end, we have settled on a compromised solution that utilizes the Initiate EID and also works within the Allscripts Touchworks requirement that it apply its own matching logic. The defined Allscripts matching logic is:

Customized Demographic Match – *3 out of 4 Match:* OtherNumber**,** Name, DOB, SSN

In Conemaugh's case, the "OtherNumber" field is the EID assigned by Initiate. Furthermore, "OtherNumber" must match, or else Allscripts treats it as a new patient and creates a new record. Our testing has shown that there are no instances in which Allscripts links records that should not be linked. There are cases in which Allscripts creates a duplicate record. This occurs due to the fact that Allscripts patient matching logic is not as sophisticated as Initiate's as referenced above. Our project team has developed management reports that identify these situations and we have a process in place for manually merging these into a single record.

Conclusion

Although we did experience a delay, we are encouraged that the current configuration will work well in our environment and that it will scale in the future to other Conemaugh physicians and to other community physicians. We were also encouraged by the level of interest that Allscripts and Initiate have taken in making this work. It is clear that both vendors realize the huge importance that accurate patient matching plays in information integration and sharing on a local and national level. Our project team learned a great deal through our experience in working through these issues. We have already provided consultative assistance with another health system facing the same situation and are open to sharing our experiences with any others who might benefit from Conemaugh's experience.

Orders

- Order interfaces and how they work with an acute care hospital is not as straight forward as it first seemed. External ordering systems do not easily integrate with hospitals with their own internal ordering systems.

Physician Notes

- From a physician standpoint check boxes are good for capturing discrete data but do not portray the physicians' thought process. Ability to free text is important to physicians. We chose to use Dragon's voice to text to allow quick entry of text.

Results

- Need method to handle large volume of patient results based on patient type, physician/patient relationship, and result type according to physician preference.

Vendor

- Critical vendor resources often lacked the necessary knowledge to support the implementation. Additionally, resources such as project manager, implementation consultant, and interface analyst were replaced multiple times throughout the course of the project due to reassignment, resignation, etc. Finally, when knowledgeable resources were assigned to the project, they often did not have the availability to focus on the

project. These frequent changes and lack of dedicated, knowledgeable resources led to countless delays in obtaining information as well as inaccurate information being received. As a result, much rework was needed to correct errors, rebuild infrastructure, reconfigure application settings, and devise solutions or workarounds via trial and error in order to achieve desired outcomes.

Overall

- While implementing first or pilot site, it is important for all parties to keep the end goal in mind.

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Acronyms

Acronym	Definition / Description
ADT	Admission, Discharge & Transfer
AHLTA	Armed Forces Health Longitudinal Technology Application
AHRQ	Agency for Healthcare Research and Quality
ANOVA	Analysis of Variance
API	Application Programming Interface
ATM	Automated Teller Machine
BHIE	Bidirectional Health Information Exchange
BMIST	Battlefield Medical Information System - Telemedicine
BMI	Body Mass Index
BP	Blood Pressure
CAT	Computed Tomography
CCHIT	Certified Commission for Health Information Technology
CCR	Continuity of Care Record
CCM	Chronic Care Model
CDE	Certified Diabetes Educator
CDI	Conemaugh Diabetes Institute
CDR	Composite Document Repository
CHS	Conemaugh Health System
CM	Configuration Management
CMS	Centers for Medicare & Medicaid Services
COTS	Commercial off the Shelf
CPG	Conemaugh Physician Group
CPOE	Computerized Physician Order Entry
CVMH	Conemaugh Valley Memorial Hospital
DHHS	Department of Health & Human Services
DOB	Date of Birth
DoD	Department of Defense
Dx	Diagnosis
ED	Emergency Department
EHR	Electronic Health Records
EIC	Electronic Information Carrier
EID	Enterprise Identification
EMPI	Enterprise Master Patient Index
EMR	Electronic Medical Record
FHIE	Federal Health Information Exchange
FHRAS	Federal Health Record Access Service
FTE	Full Time Equivalent

FY	Fiscal Year
GOTS	Government off the Shelf
GUI	Graphical User Interface
HB	House Bill
HD	High Definition
HDL	High-density Lipoprotein
HIE	Health Information Exchange
HIN	Health Information Network
HIPAA	Health Insurance Portability and Accountability Act
HITECH	Health Information Technology for Economic and Clinical Health Act
HIT	Health Information Technology
HL7	Health Level 7
H&P	History and Physical
IM	Internal Medicine
IOM	Institute of Medicine
IRB	Memorial Medical Center Institutional Review Board
IT	Information Technology
JAR	JAVA Archive
LPN	Licensed Practical Nurse
MHS	Military Health System
MNT	Medical Nutrition Therapy
MIDHT	Military Interoperable Digital Hospital Testbed
MIS	Management Information Systems
MMC	Memorial Medical Center
MIS	Management Information Systems
MIMC	Miners Medical Center
MRI	Magnetic Resonance Imaging
MTF	Military Treatment Facility
MYMC	Meyersdale Medical Center
NCHC	Norcam Community Health Center
NEJM	New England Journal of Medicine
NGC	Northrop Grumman Corporation
NHLBI	National Heart, Lung, and Blood Institute
NHIN	Nationwide Health Information Network
NSTC	National Science and Technology Council
ONCHIT	Office of the National Coordinator for Health Information Technology
OS	Operating System
PACS	Picture Archive and Communication System
PA	Pennsylvania
PA	Physician Assistant
PDA	Personal Digital Assistant

PHR	Personal Health Record
PHI	Protected Health Information
PHC	Portage Health Center
RBRVS	Resource Based Relative Value Scale
RVU	Relative Value Unit
ROI	Return On Investment
RHIOs	Regional Health Information Organizations
RN	Registered Nurse
SAML	Security Assertion Markup Language
SAN	Storage Area Network
SW PA	Southwestern Pennsylvania
SME	Subject Matter Expert
SMS	Secure Messaging System
SOAP	Simple Object Access Protocol
SOW	Statement of Work
SSL	Secure Sockets Layer
SSN	Social Security Number
TADO	Technical Architecture Design Overview
TATRC	Telemedicine and Advanced Technology Research Center
TMS-AP	Time and Motion Study Ambulatory Practice
TNPs	TRICARE Network Providers
TTM	Transtheoretical Model
USAMRMC	United States Army Medical Research and Materiel Command
USB	Universal Serial Bus
VA	Department of the Veterans Administration
VISTA	Veterans Health Information Systems & Technology Architecture
VPN	Virtual Private Network
VTC	Video Teleconferencing
WAN	Wide Area Network
WSDL	Web Service Definition Language
XML	Extensible Markup Language
XSP	Extensible Server Pages

Appendices

A. ***Personal Health Record (PHR) Manuscript***

B. ***Initiate Enterprise Master Patient Index (EMPI)***

C. ***McKesson Patient Folder***

D. ***Cloverleaf Interface Threads***

E. ***Allscripts Electronic Health Record (EHR)***

F. ***Physician Office Workflow***

G. ***Physician HIT Survey Results***

H. ***Hospital-based HIT Survey Results***

I. ***Military Healthcare Survey Results***

J. ***Nutrition & Fitness Journal Survey Results***

Appendix A: Personal Health Record (PHR) Manuscript

ORIGINAL RESEARCH

Will Electronic Personal Health Records Benefit Providers and Patients in Rural America?

John S. Hargreaves, M.B.A.

Memorial Medical Center, Johnstown, Pennsylvania.

Abstract

Purpose: The objective of this study was to educate stakeholders (e.g., providers, patients, insurers, government) in the healthcare industry about electronic personal health records (PHRs) and their potential application in rural America. Methods: Extensive research was performed on PHRs through standard literature search, product demonstrations, educational webinars, and fact finding via news releases. Results: Various stakeholders are eager to transform the healthcare industry into the digital age like other industries (i.e., banking, retail). Despite low adoption of PHRs in 2008 (2.7% of U.S. adults), patients are interested in secure messaging and eVisits with their physicians, online appointment scheduling and reminders, and online access to their laboratory and radiology results. Federal agencies (e.g., Health and Human Services, Department of Defense, Veterans Affairs [VA]), popular information technology (IT) vendors (e.g., Google, Microsoft), and large insurers (e.g., Aetna) have energized the industry through pilot programs and new product announcements. It remains to be seen if barriers to adoption, including privacy concerns, lack of interoperability standards and funding, and provider resistance, can be overcome to enable PHRs to become a critical tool in the creation of a more efficient and less costly U.S. healthcare industry. Conclusions: Electronic PHRs hold great promise to enhance access and improve the quality of care provided to patients in rural America. Government, vendors, and insurers should create incentives for providers and patients to implement PHRs. Likewise, patients need to become more aware of PHRs and their ability to improve health outcomes.

Key words: *access and quality, personal health record, consumer empowerment, rural health, eVisit, secure messaging*

Introduction

Many healthcare stakeholders have become engaged with electronic personal health records (PHRs) in the last few years, including consumers, hospitals/health systems, physicians, government (e.g., Department of Defense [DoD], Department of Health and Human Services [HHS], Medicare), insurance companies (e.g., Aetna), web companies (e.g., Google), and employers (e.g., Wal-Mart).[1] This article educates the reader about a PHR, provides select adoption drivers and barriers, and highlights how a PHR could provide benefits in rural America.

According to the Markle Foundation, PHR is defined as "an Internet-based set of tools that allows people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it."[2]

PHRs are designed to be patient centric and empower consumers to take a more active role in their healthcare. To be successful, PHRs must spur new thinking by patients and providers alike. Ultimately, PHRs provide a way for patients to electronically communicate with individuals and organizations involved in their care. PHRs allow consumers to keep their health records organized in one location, as opposed to having them scattered in multiple physician offices, hospitals, and pharmacies. PHRs can help reduce the possibility of medical errors and duplicative testing and can also provide emergency access to health records, which may save lives.

Methodology

A standard literature review of PHRs was performed using PubMed, Ovid, and Science Direct as the main databases. The following search terms were utilized: electronic personal health

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records, personal health records, PHRs, secure messaging, online consultations, and consumer informatics. Results were restricted to full text and published within the last 5 years. Additional information was obtained through fact finding via direct communication, press releases, PHR webinars, and organizations such as the Markle Foundation, Office of the National Coordinator for Health Information Technology, and Center for Information Technology Leadership. Content that involved PHR adoption/attitudes, PHR functions, PHR architecture, and PHR privacy/security was selected for inclusion.

Electronic PHR Adoption and Attitudes of Providers/Patients

Electronic PHR adoption by consumers and providers has been slow in the United States because of varying factors. According to a 2008 consumer survey of 1,850 adults commissioned by the Markle Foundation, only 2.7% of U.S. adults (6.1 million persons) utilize electronic PHRs. The most cited reasons for a lack of interest are concerns about the protection of medical information and how it would be shared.[3] To combat such concerns, Connecting for Health, a public–private collaborative group engaging more than 100 organizations representing all major stakeholders of the healthcare industry, published a Common Framework for Networked Personal Health Information. This framework provides a roadmap for establishing trust among all participants and encourages the appropriate treatment of personal health information (PHI) when electronically shared across various distinct networks.[4]

A Deloitte Center for Health Solutions[5] 2009 Survey of Health Care Consumers stated that 57% of respondents want a secure Internet site that would enable them to access their medical records, schedule office visits, refill prescriptions, and pay medical bills. Additionally, 55% of respondents are interested in e-mail access with their doctor and 42% of respondents are interested in a PHR that is connected to their doctor's office. It is evident that electronic PHRs can help close the gap between consumers' expectations and what they are actually receiving from physicians.

Many physicians are ingrained with the current visit-based method of care and have been slow to recognize and implement electronic PHRs in their respective practices. A significant provider complaint is the lack of a reimbursement mechanism to pay for their time spent reviewing medical information contained within an electronic PHR. Hope may be on the horizon as numerous third-party payers have recently launched PHR pilot programs with beneficiaries, including Medicare, Aetna, Blue Cross and Blue Shield, and United Health Group.[6–9] Physicians also cite additional barriers to adoption, including license cost, technical expertise needed, the lack of an industry standard for integrating with electronic medical record (EMR) systems, and the electronic PHRs' dependency upon the consumer to update frequently with accurate medical information.[10]

In a cross-sectional study involving ambulatory care providers in Nebraska and South Dakota, a majority (60%) of the surveyed providers were not aware if their patients used an electronic PHR. The study also concluded that only 9% of physicians used data contained within the electronic PHR to make patient care decisions. However, physicians did witness hand-written medication lists 91% of the time, which signals that consumers are keeping traditional PHRs. The survey response rate was low at 22% and may involve a considerable bias. In general, there is an overall lack of awareness about PHRs by physicians and consumers; it may take many years for PHR usage and acceptance to become mainstream.[11]

An online survey of 4,282 members of Geisinger Health System's PHR (MyChart) resulted in mostly positive feedback. The application allows patients to communicate electronically with providers and to view selected portions of their provider-based EMR. The response rate to the survey was fair at 33% or 1,421 users. In general, patients prefer electronic communications more than physicians. Sixty-four percent of patients preferred renewing prescriptions online, 53% of patients preferred getting answers to general medical questions online, 45% of patients preferred discussing healthy lifestyle choices electronically, and 32% of patients preferred access to test results electronically. But, physicians preferred renewing prescriptions electronically (44%) slightly more than by telephone (38%). Physicians overwhelmingly preferred discussing general medical questions by phone (44%) and in person (38%). Further, physicians prefer discussing healthy lifestyle choices in person (44%) and providing test results in writing (44%). The sample size was small for physicians and so generalizations are problematic. The majority of patients were satisfied with the accuracy and completeness of their medical information contained within the EMR and most patients were not concerned about confidentiality/privacy of their data or learning of test results before discussing by phone with providers. Geisinger Health System is located in 31 counties in north central Pennsylvania and is the largest rural health maintenance organization in the nation.[12]

A PHR pilot in the rural community of Willmar, Minnesota, revealed future benefits to patients and caregivers. Enrolled patients utilized the myHealthfolio® PHR from Avenet Web Solutions and were patients of the Rice Heart Failure Clinic. The average age was 72 years and many were computer illiterate. A structured study design had participants meet with staff three times over a 3-month period to set-up and review the PHR. Participants did not use the PHR outside of those appointments. Laboratory results were interfaced to the PHR

from the clinic's EMR. The following results were obtained from 10 participants via surveys and focus groups that agreed a PHR was a useful tool in the following ways[13]:

- Organize medications so that your doctors have a complete list—100%
- Access your diagnostic reports, such as laboratory tests—100%
- Organize your current personal health history, such as medications, surgeries, immunizations, and illnesses—100%
- Organize your family records, such as your family's doctors, health plans, and care providers—80%
- Forward your health history and records to new doctors via paper or computers—100%
- Receive announcements about health education and health alerts—30%
- Receive calendar reminders for important health events—30%
- Educational information on self-management of specific illnesses, such as heart disease—100%

Caution should be taken given the sample size and intervention period but limited results are available for rural PHR applications.

Recent findings from the 19th Annual Modern Healthcare/Modern Physician Survey of Executive Opinions on Key Information Technology states that healthcare leaders are interested in PHRs, but many healthcare organizations have not implemented them to date (36.8% of respondents selected PHRs as the information technology (IT) system they plan to go after but have not started). Further, 14.8% of respondents were in the process of implementing a PHR, whereas only 3.9% respondents already have implemented a PHR. It is clear that healthcare leaders have a curious interest in PHRs but other investments are more pressing.[14]

Adoption Drivers

The main drivers for the adoption of PHRs appear to be large health plans (insurers), patients, employers, and governmental agencies. PHRs empower consumers to take control of their healthcare through electronic management of their data and communication with providers, which benefits all stakeholders through improved quality of care, safety, efficiency, and cost savings.

Members of Cigna Healthcare have had the opportunity since January 2008 to interact with physicians online through "virtual house calls" developed by Relay Health. Patients discuss nonurgent health issues with physicians through structured interviews. This service is available nationwide and 12,000 physicians and 170,000 patients have used the new system.[15]

Aetna has been on the forefront of clinical decision support information at the point of care. Through its NaviNet®, physicians and office staff receive pop-up alerts electronically, which identify gaps in care or opportunities for better care through evidence-based "Care Considerations." Aetna patients can also make available their PHRs to physicians through NaviNet. Since April 2008, this technology has been implemented in nearly half of Aetna's physician network. Aetna's interactive PHR also uses Care Considerations, where patients' test results, medications, etc., are compared with nationally recognized best practices. E-mail alerts are sent to members and, in some cases, physicians to alter treatment plans accordingly. As of May 2008, 6 million members are utilizing Aetna's PHR.[15]

An informal market assessment of the top five payers to the Conemaugh Health System, located in southwestern Pennsylvania, stated that 40% are currently offering electronic PHRs to their members. Medicare currently offers PHR pilot programs for beneficiaries living in South Carolina, Arizona, and Utah. Additionally, several Medicare Advantage and Part D members have access to PHRs.[16] Highmark Blue Cross Blue Shield and University of Pittsburgh Medical Center (UPMC) Health Plan offer comprehensive electronic systems for members who can access topics such as coverage information, financial data (e.g., claims), personal health data (e.g., medications), provider information, and important health topics. Penn Highlands Health Plan, a provider-sponsored Provider Preferred Organization (PPO) and Pennsylvania (PA) Access Plus (Medical Assistance), currently do not offer electronic PHRs to their members.

Consumers have shown through multiple national surveys that have a strong interest in conducting healthcare-related activities electronically through the Internet. Supporting the aforementioned Deloitte Center for Health Solutions[5] survey results, a 2007 Wall Street Journal Online/Harris Interactive Poll showed that 91% of respondents (2,153 U.S. adults) agreed that patients should have access to their own EMRs maintained by their physician. Further, 77% believed that medical offices should provide patients with the ability to schedule appointments via e-mail or on the Internet and 75% believed that patients should be able to e-mail their doctors as part of their overall care, with no additional charge.[17]

Employers are also proponents of PHRs as a means to reduce healthcare insurance spending on employees. Dossia, a not-for-profit consortium of nine large employers, has moved forward with its plans to provide 5 million employees, dependents, and retirees with PHRs. The employers include Applied Materials, AT&T, BP America, Cardinal Health, Intel, Pitney Bowes, Sanofi-Aventis, Abraxis BioScience Inc., and Wal-Mart. The Dossia Founders Group is working with Children's Hospital Boston and other qualified and experienced vendors to develop and implement the Dossia personally controlled health record.[18]

Federal agencies, including the DoD, Department of Veteran Affairs, and Centers for Medicare and Medicaid Services, have been active over the past few years implementing PHR systems in production or pilot environments.

MyHealtheVet, offered to veterans by the Veterans Affairs (VA) since 2000, has been the most successful effort to date as agreed upon during a roundtable hosted by the U.S. Medicine Institute for Health Studies in 2008. Some members of the roundtable urged that the healthcare industry needs a paradigm shift toward wellness and prevention, which may overcome the underlying fragmentation.[1]

The DoD is currently involved in a PHR pilot at Madigan Army Medical Center in Tacoma, Washington. The prototype "MiCare" PHR has the ability to integrate with Microsoft or Google's platform. Military beneficiaries who decide to participate can receive their medical data contained within Armed Forces Health Longitudinal Technology Application (AHLTA) for storage in their PHR, along with data from private sector providers, pharmacies, and insurers. DoD has plans to expand the PHR pilot to two other areas to test additional functionality (e.g., secure messaging) and access larger military populations. DoD leadership strongly supports the adoption of PHRs as a tool to allow patients to take more responsibility for their healthcare, enhance quality and continuity of care, and provide a mechanism for electronic communication between patients and providers via the Internet.[19]

The Nationwide Health Information Network is currently being spearheaded by the federal government to establish a network of networks based upon national interoperability standards and open source technology. The main goal is to provide a mechanism to allow for national health information exchange between disparate systems located in the public and private sectors to improve the quality and efficiency of care while lowering healthcare costs. A demonstration was conducted at the Nationwide Health Information Network Connect Seminar in June 2009 in Washington, DC, involving Relay Health (vendor) and Spartanburg Regional Health System. The "Use Case" demonstrated private sector physician and patient access to medication history, allergies, and diagnosis data from DoD through an online consultation via a PHR.[20]

Adoption Barriers

As with electronic health record (EHR) adoption, adoption barriers are not limited to financial concerns. Many believe that PHRs can be most useful when integrated with EHRs. The mere fact that many hospitals and physicians, especially in rural areas, do not have EHRs is the greatest environmental barrier. Second, the lack of a ubiquitous EHR system in the market place presents additional technical challenges as patient data may reside in multiple EHR systems, and thus integrated PHRs must reach across organization boundaries.[21]

Legal and privacy concerns are also major barriers for widespread PHR adoption. Some providers may have legitimate concerns about the accuracy of patient entered data when used to aid in treatment decisions. Patients appropriately desire protection of their private health information and aggressive security requirements may impede optimal care.[21]

The utilization of PHRs requires a behavioral change by patients and providers. Consumers must understand their responsibility related to their healthcare and the importance of maintaining and coordinating documentation with their providers. Providers will need to adjust workflows, develop different mindsets, and trust information in PHRs appropriately.[21]

Further, the telecommunications infrastructure in rural America may significantly impact the experience of patients and providers using the Internet via a dial-up connection. A May 2006 report released by the Government Accountability Office found that 17% of rural households subscribe to broadband, as opposed to 28% of suburban and 29% of urban households. The Pew Internet and American Life Project found that the percentage of U.S. adults who have broadband at home is 52% for urban areas, 49% for suburban areas, and 31% for rural areas. On a positive note, 2008 Federal Communications Center (FCC) data depict that high-speed subscribers were reported in 99% of the most densely populated zip codes, as opposed to 91% of zip codes with the lowest population densities.[22] It is clear that broadband access is improving and the growth of PHRs will have to coincide with increased broadband usage in all areas.

An informal market assessment was performed of local hospitals and health systems in rural southwestern Pennsylvania. Chief Information Officers were asked if they were currently interfacing clinical systems to PHRs or had plans to implement within the next 12 months. The following organizations all responded with a "No" to both questions: Conemaugh Health System, Altoona Regional Health System, Somerset Hospital, Indiana Regional Medical Center, and Excela Health and Windber Medical Center. These results predict that it may be years until PHR integration with clinical information systems becomes a top priority for providers.

Electronic PHR Functions

Many PHRs have similar functions and services that enable consumers to manage their health by compiling their PHI from varied sources (e.g., medications, laboratory results, allergies, surgeries, office visits, conditions, family histories) in one place. Many popular PHRs are electronic, which makes them available anywhere and anytime if there is an available connection to the Internet. This ease

Table 1. Common PHR Functions

Appointment scheduling/reminders	Health-tracking tools (graphs)
Access to medical records (i.e., laboratory tests)	Patient diaries (pain and symptoms)
Chronic disease management	Patient education and care guides
Drug interactions checking	Preventive service reminders
e-Visits/consults	Request medication refills
Financial information	Secure web messaging with physician(s)
	Store allergies, medications, conditions, and medical history information

of access is especially important in an emergency situation and could ultimately help save a life. As the consumer controls the PHR, the following data may be added as well: food allergies, health conditions, over the counter/herbal medications, physician list, and emergency contacts.

Advanced PHRs allow consumers to become more informed about their health status and share personal data with those providing care to them and their family members. The PHR functions[23] listed in *Table 1* are possible depending on the PHR application utilized. There are over 100 PHR vendors in the market today, including Medfusion, Relay Health, CapMed, Google Health, Microsoft Healthvault, Health Trio, No More Clipboard, and Patient Gateway.

The healthcare industry in a systematic manner must determine which functions of a PHR provide the greatest value to each stakeholder. The resulting analysis will have a great impact on who funds PHR development, which functions are supported, and who will pay to use these systems.[24] Further research and education are needed at all levels of engagement within the healthcare industry. PHR funding remains an open issue and is particularly interesting in cases of PHR integration with provider-based EMRs.

Electronic PHR Architecture

Commonly described as the ideal PHR configuration is a Hub-and-Spoke model (*Fig. 1*, adapted from Ref.[25]) with the patient-managed PHR at the epicenter surrounded by multiple stakeholders (data sources) that are involved in the patient's complete healthcare delivery continuum. The PHR system should be able to transmit and receive (bidirectional) healthcare data from disparate and distinct sources, as authorized by the patient, to provide a complete and longitudinal healthcare picture.

Although there are currently no regulatory or industry PHR design standards, most of the in-use PHRs can be categorized into one of the following design models:

- Provider-Tethered—connected with a provider's EMR for health information exchange (i.e., hospital/physician office)
- Payer-Tethered—connected with the patient's insurer for claims based exchange of data (i.e., Medicare)
- Third Party—combine data from different sources into one place (e.g., Google)
- Interoperable—populated with data from all sources via standard-based automated data exchange; most complete and useful model (i.e., Hub-and-Spoke)
- Free Standing—not connected to any other systems

Issues in implementing Provider-Tethered PHRs are important to discuss and are a logical next step for the industry. To be truly successful, PHRs and EHRs must be able to exchange data freely. The current problem is a lack of a universally accepted interoperability standard, such as the Continuity of Care Record. Policy makers, vendors, providers, and patients must unite to forge ahead with one interoperability standard between varied PHR and EHR systems in the market place.

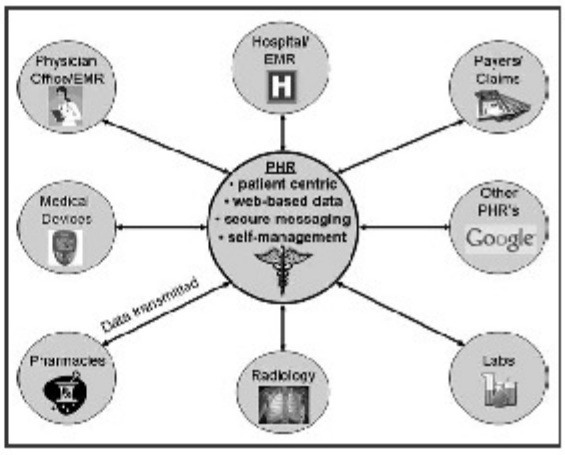

Fig. 1. Hub-and-Spoke model.

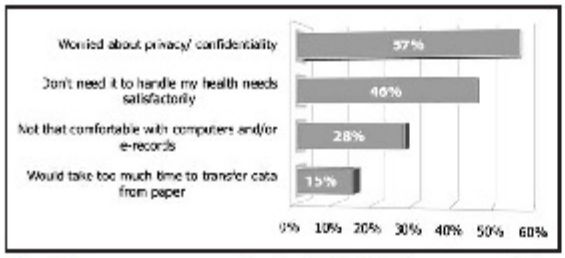

Fig. 2. Privacy concerns: more than half (56.8%) of these respondents not interested in PHRs cited "worries about privacy and confidentiality." Traits of people with privacy concerns higher than the general public included $100,000 or greater annual income, married, 30–44 years in age, female, some college or BA, with a major disability, in very good health, and caregiver for a child. This graph is used with permission from the Markle Foundation (www.markle.org). It was originally published in June 2008 by the Markle Foundation in a research brief entitled "Americans Overwhelmingly Believe Electronic Personal Health Records Could Improve Their Health." This document is available in its entirety at www.connectingforhealth.org/resources/ResearchBrief-200806.pdf. PHRs, personal health records.

Other issues on the table include data ownership: does the patient have the right to alter professionally sourced documents in their PHR? Two industry leaders differ on this exact issue. Google Health does not allow customers to alter professionally sourced documentation, whereas Microsoft Healthvault does allow revisions, which are flagged and also contain audit trails with previous values. Connecting for Health's Common Framework for Networked Personal Health Information insists on an "immutable audit trail" and also states "there is no default source of truth." The framework believes that the audit trail must accompany the PHR when electronically shared outside the PHR environment.[26]

Electronic PHR Privacy and Security

For patients to fully benefit from an electronic PHR, it must be connected with various and distinct data sources. Thus, both patients and regulators have great concerns regarding the privacy and security of PHI when exchanged and stored over the Internet. In a national survey, commissioned by the Markle Foundation, of 1,580 American adults, more than half of the respondents (56.8%) who were not interested in PHRs cited "worries about privacy and confidentiality," as depicted in *Figure 2*.[3]

Additionally, 91% of patients are adamant that all online services handling their PHI should require them to express agreement for each use.[3] This crucial point of discussion shows that consumers want explicit control over how their information is handled. Privacy policies within the PHR industry are currently inconsistent. A sticky issue exists regarding PHRs and the Health Insurance Portability and Accountability Act (HIPAA). In the past, PHR vendors were not covered under HIPAA, but organizations that maintain PHRs (i.e., healthcare providers, health plans) are subject to compliance as covered entities.[4] Industry and government stakeholders are now currently analyzing the impact of the bolstered HIPAA privacy and security measures within the 2009 American Recovery and Reinvestment Act signed into law by President Obama.[27]

Several organizations have recently published information to advance the PHR privacy and security discussion. Highlighted in the following paragraphs is HHS' PHR Privacy Notice Model (Draft) and the Connecting for Health's Common Framework for Networked Personal Health Information.

HHS undertook a research project to help consumers more clearly understand and compare privacy policies across PHRs. HHS has created a "plain language" draft model of a PHR fact sheet that is similar to other industries (i.e., food and financial services). This document will undergo revisions based upon feedback from the public and private sectors, including consumer testing. A final template is expected to be released for use by PHR vendors to educate potential consumers. The PHR Facts-at-a-Glance includes the following sections[28]:

- PHR type
- Who can view your personal information?
- How we may use your personal information?
- What are our policies about closing your PHR?
- When will you be notified?
- How do we store and protect your personal information?
- Full printable version
- Contact information

The Connecting for Health's Common Framework for Networked Personal Health Information "provides a foundation for maintaining trust among all participants—business, professional, and consumer—in electronic health information networks."[4] The framework depicted below (*Fig. 3*) involved over 100 public and private companies from the healthcare industry. It sets forth practices to promote trust among a multitude of varied stakeholders and to provide guidance to organizations participating in health information exchange.

adoption of this technology is the lack of reimbursement for such an eVisit from many insurers.[31]

Relay Health, a PHR vendor, released the following results from an independent webVisit study involving 367 patients and 89 physicians: two-thirds of responding patients rated the quality of their online physician consultations as "good" to "excellent" when compared with an in-office visit; 87% rated the quality of the webVisit favorably compared with an office visit when the physician responded by the next business morning. Over half of all patients surveyed and 66% of those who received a physician response by next business morning found that the service improved access to their own physician. Over half of physicians responding (56%) preferred the webVisit to an in-office visit for handling nonurgent patient healthcare needs. In summary, the surveyed patients who used Relay Health during the study were 50% less likely to report having missed work because of illness, 45% less likely to report having visited the doctor, and 36% less likely to report having telephoned the physician's office.[32]

Quality

PHRs can enhance the quality of healthcare in the United States. Medical errors, duplicative tests, and safety concerns have plagued the healthcare industry for many decades. The following statements[23] portray a fragmented, broken system:

- One in four prescriptions taken by a patient are not known to the treating physician.
- One in five laboratory and X-ray tests are ordered because originals cannot be found.
- Patient data are unavailable in 81% of cases in one clinic, with an average of four missing items per case.
- 18% of medical errors are estimated to result from inadequate availability of patient information.
- 40% of outpatient prescriptions are unnecessary.
- Patients receive only 54.9% of recommended care.

PHRs can provide the missing link to solve the above problems. PHRs that are interoperable with pharmacies and EMRs can electronically provide accurate and complete medication lists to the treating physician, thereby improving health outcomes and patient safety. PHRs may also contain crucial laboratory and radiology data, which again can be provided to the treating physician at the discretion of the patient to reduce the likelihood of duplicative tests. Further, patient diaries and home medical devices (i.e., glucose meter) can also provide further medical information to healthcare providers and aid their decision-making ability. PHRs can help patients who struggle with chronic diseases through self-management tools. For example, some PHRs have preventive service reminders and educational materials that allow patients to better control their conditions through online tools (i.e., diabetes management). Finally, a printed PHR can be invaluable in emergency situations, in which providers can locate a complete medical history quickly and potentially save a life.

Conclusion

Health information technology promises to improve efficiency of the healthcare industry through a higher quality of care, a reduction in medical errors and duplicative tests, improved patient safety, and an overall decline in healthcare costs. However, adoption of EMRs and PHRs remains low in the United States. PHRs are Internet-based tools that allow patients to take control of their lifelong healthcare information and to share components of it with whom they choose (i.e., providers and family members). Numerous surveys report that patients want access to secure messaging, eVisits, online appointment scheduling, and laboratory results. Unfortunately, PHR adoption is low because of privacy/security concerns, varying architectures, numerous vendors, lack of interoperability standards, and provider resistance.

Benefits of PHRs may be felt the most in rural America. As telecommunications infrastructures are upgraded in these areas, patients can greatly improve their access to healthcare providers through Internet technologies. Patients can communicate with caregivers electronically regarding nonurgent issues while foregoing time-consuming, traditional office-based visits and phone calls. Additionally, greater access can be gained to specialists located in urban areas regarding innovative and specialized treatment options for their medical conditions. Electronic PHRs will improve the healthcare experience provided through information exchange with respective physicians, pharmacies, hospitals, and insurers. Provider access to current and complete medication lists is a chronic problem in the industry, which can be aided through electronic PHRs and information sharing.

Industry stakeholders must address future PHR funding to electronically connect patients and providers and to create a more connected healthcare system. Government, insurers, providers, and vendors should determine which functions provide the greatest value to each stakeholder group and fund accordingly as consumers are unlikely to pay for PHRs. Previous research studies have shown that PHRs are successful in reducing nonurgent office visits and phone calls regarding scheduling and prescription refills, thus improving satisfaction and lowering healthcare costs. The quality of care provided and decision-making can be enhanced through electronic access by providers to patients' medication lists, allergies, family

histories, laboratory and radiology results, medical devices, and clinical encounter documentation. Finally, government regulators and PHR vendors must compromise on a security and privacy standard, thus alleviating those concerns and the appropriate electronic protection of PHI.

Incentives must be created to spur adoption by patients and providers. For example, insurance groups could offer lower premiums to members who utilize PHRs and the amount could be based upon the frequency of data exchange with stakeholders. Additionally, HHS' support of PHRs in the "meaningful use" requirements under the HiTech Act of 2009 is a positive factor for the industry. This topic is addressed under the "Engage Patients and Families," which is listed 2 out of 5. Furthermore, the matrix also "accelerated the time table for physician practices/hospitals to provide a patient with a PHR, populated in real-time with their PHI from 2015, to 2013."[33] The meaningful use requirements as stated today should spur implementation of PHRs.

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Disclosure Statement

No competing financial interests exist. The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other documentations.

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Address correspondence to:
John S. Hargreaves, M.B.A.
Memorial Medical Center
1086 Franklin St.
Johnstown, PA 15905

E-mail: jhargrea@conemaugh.org

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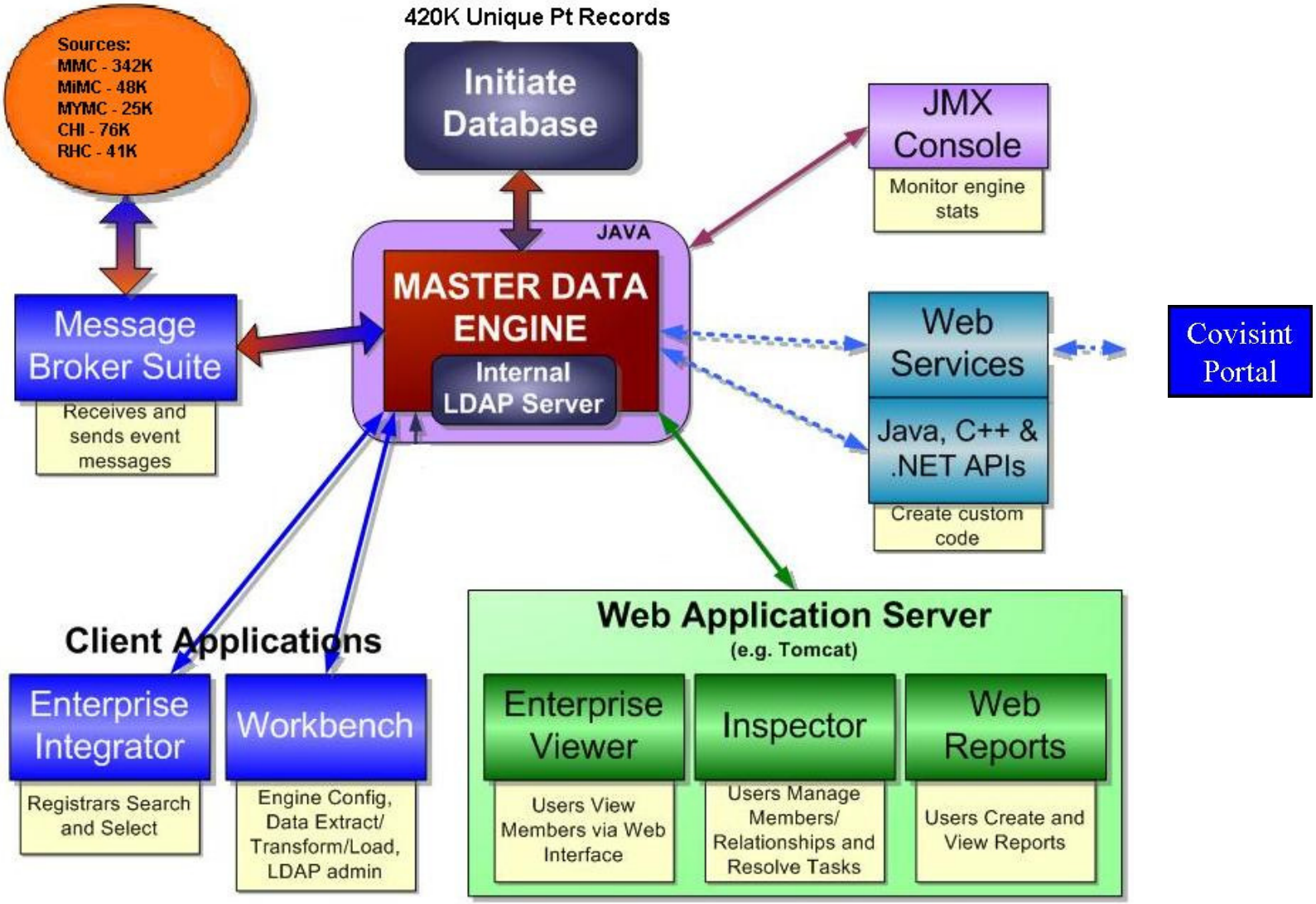
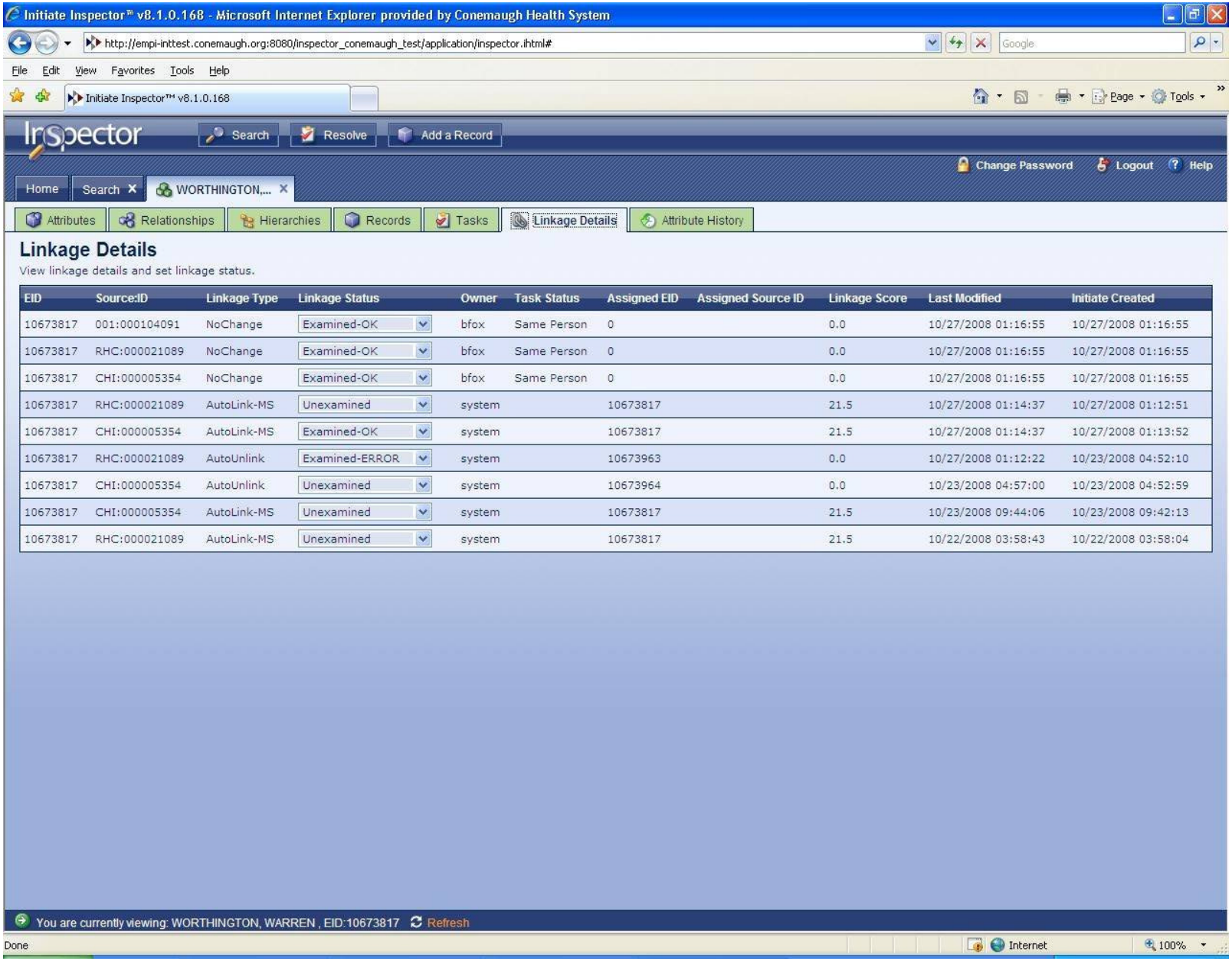
Appendix B: Initiate Enterprise Master Patient Index (EMPI)


420K Unique Pt Records
Sources:
MMC - 342K
MiMC - 48K
MYMC - 25K
CHI - 76K
RHC - 41K
Initiate Database
JMX Console
Monitor engine stats
JAVA
MASTER DATA ENGINE
Internal LDAP Server
Message Broker Suite
Receives and sends event messages
Web Services
Java, C++ & .NET APIs
Create custom code
Covisint Portal
Client Applications
Enterprise Integrator
Registrars Search and Select
Workbench
Engine Config, Data Extract/ Transform/Load, LDAP admin
Web Application Server
(e.g. Tomcat)
Enterprise Viewer
Users View Members via Web Interface
Inspector
Users Manage Members/ Relationships and Resolve Tasks
Web Reports
Users Create and View Reports



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10673817	RHC:000021089	NoChange	Examined-OK	bfox	Same Person	0		0.0	10/27/2008 01:16:55	10/27/2008 01:16:55
10673817	CHI:000005354	NoChange	Examined-OK	bfox	Same Person	0		0.0	10/27/2008 01:16:55	10/27/2008 01:16:55
10673817	RHC:000021089	AutoLink-MS	Unexamined	system		10673817		21.5	10/27/2008 01:14:37	10/27/2008 01:12:51
10673817	CHI:000005354	AutoLink-MS	Examined-OK	system		10673817		21.5	10/27/2008 01:14:37	10/27/2008 01:13:52
10673817	RHC:000021089	AutoUnlink	Examined-ERROR	system		10673963		0.0	10/27/2008 01:12:22	10/23/2008 04:52:10
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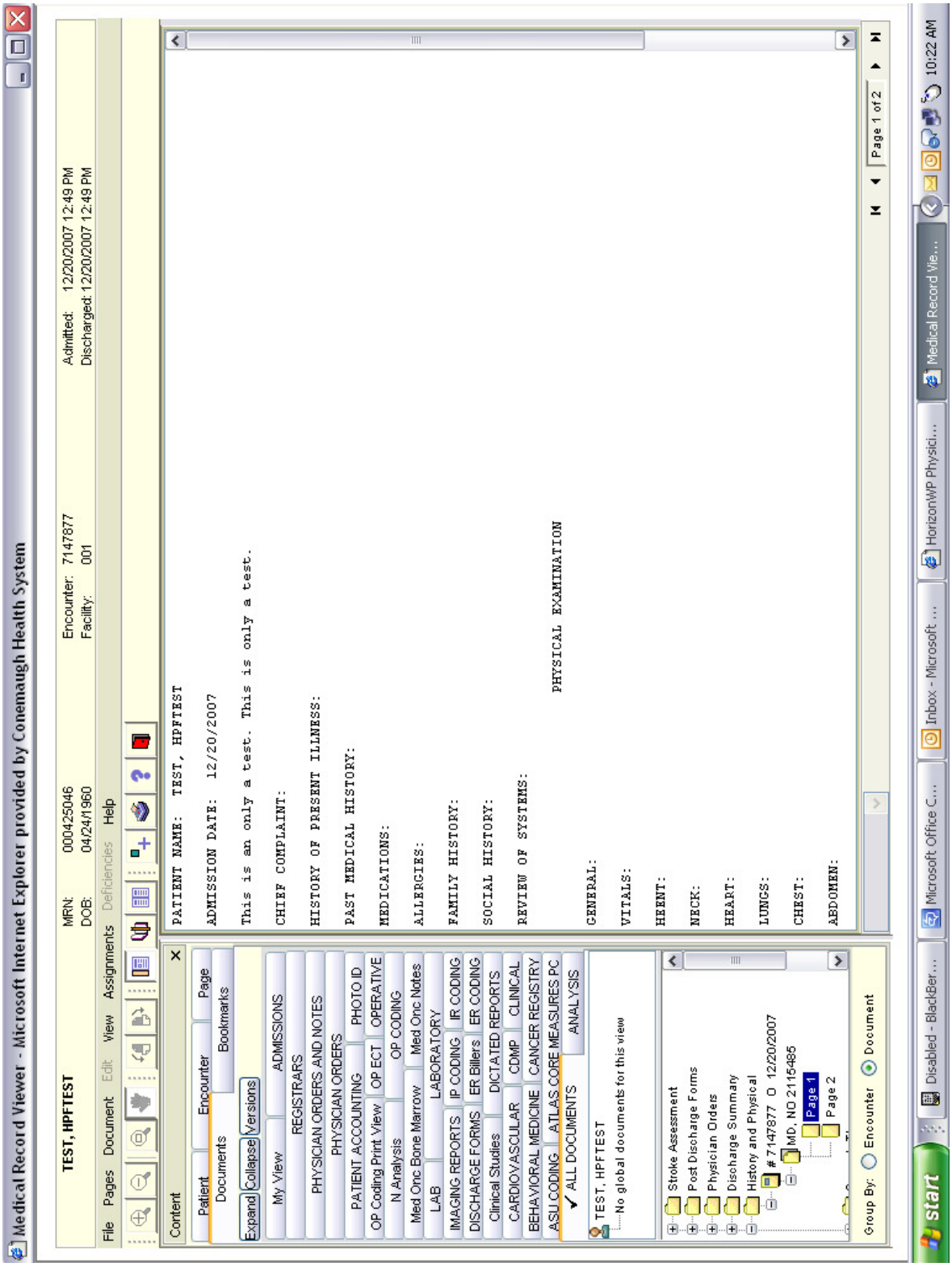
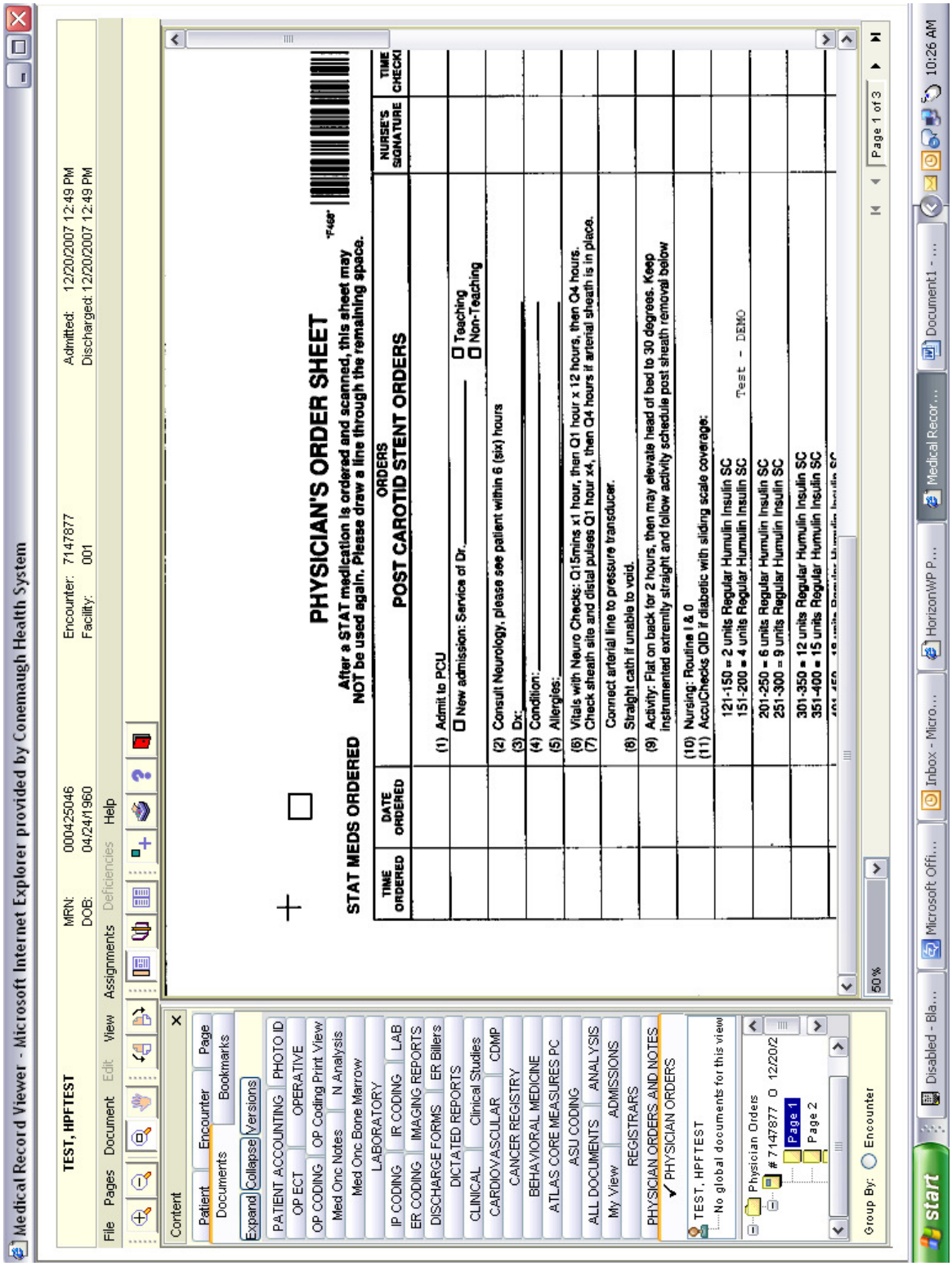
10673817	RHC:000021089	AutoLink-MS	Unexamined	system		10673817		21.5	10/22/2008 03:58:43	10/22/2008 03:58:04

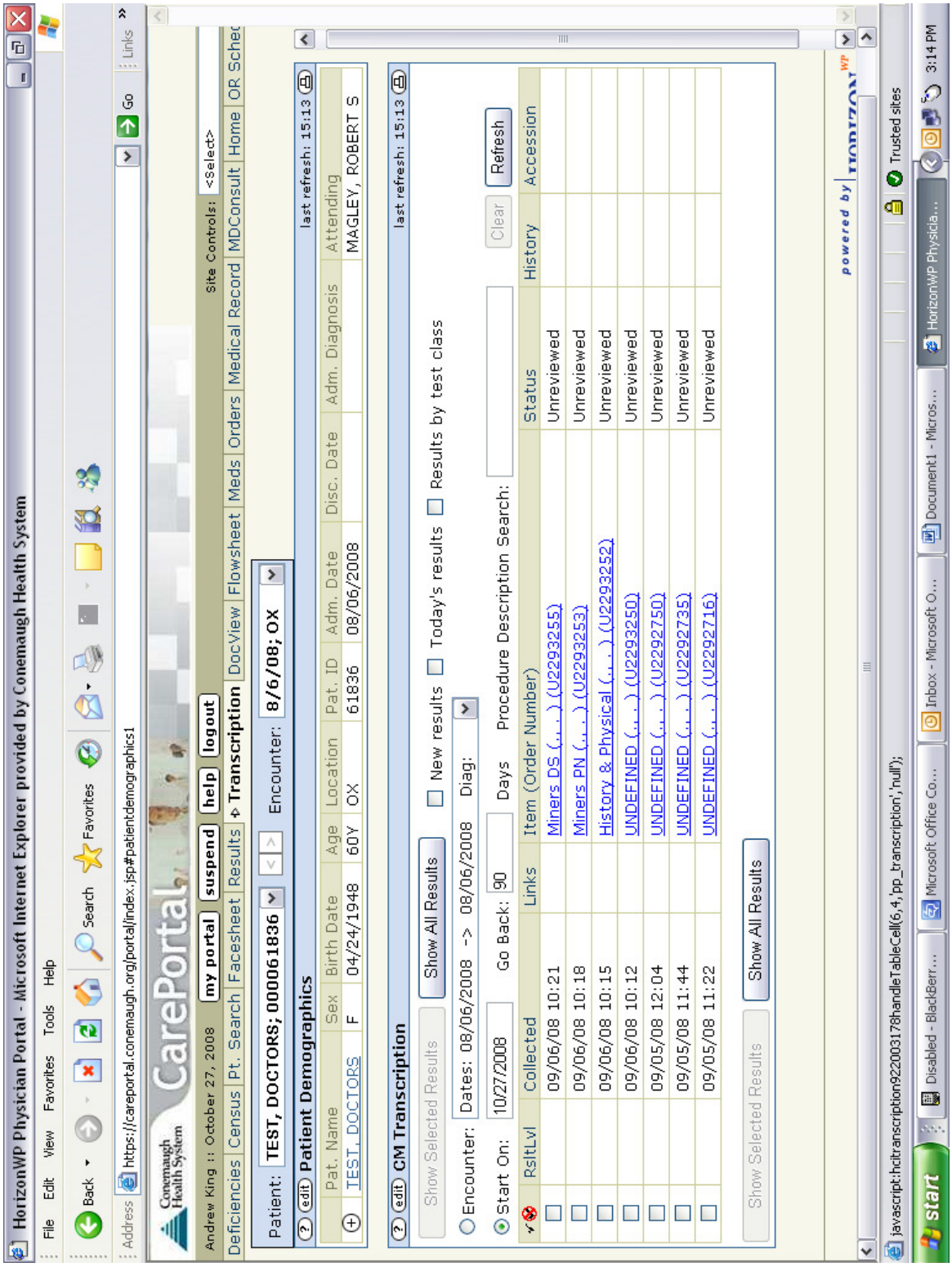
Appendix C: McKesson Patient Folder

Medical Record tab selected from CHS Care Portal viewing COLD feed H&P



Viewing scanned physician order from Medical Record tab




HorizonWP Physician Portal - Microsoft Internet Explorer provided by Conemaugh Health System
CarePortal
Andrew King :: October 27, 2008
my portal
suspend
help
logout
Site Controls:
Deficiencies | Census | Pt. Search | Facesheet | Results | Transcription | DocView | Flowsheet | Meds | Orders | Medical Record | MDConsult | Home | OR Sched
Patient: TEST, DOCTORS; 000061836
Encounter: 8/6/08; OX
Patient Demographics
last refresh: 15:13
Pat. Name | Sex | Birth Date | Age | Location | Pat. ID | Adm. Date | Disc. Date | Adm. Diagnosis | Attending
TEST, DOCTORS | F | 04/24/1948 | 60Y | OX | 61836 | 08/06/2008 | | | MAGLEY, ROBERT S
CM Transcription
last refresh: 15:13
Show Selected Results
Show All Results
New results
Today's results
Results by test class
Encounter: Dates: 08/06/2008 -> 08/06/2008 Diag:
Start On: 10/27/2008 Go Back: 90 Days Procedure Description Search:
Clear
Refresh
RsltLvl | Collected | Links | Item (Order Number) | Status | History | Accession
09/06/08 10:21 | Miners DS (,,,,) (U2293255) | Unreviewed
09/06/08 10:18 | Miners PN (,,,,) (U2293253) | Unreviewed
09/06/08 10:15 | History & Physical (,,,,) (U2293252) | Unreviewed
09/06/08 10:12 | UNDEFINED (,,,,) (U2293250) | Unreviewed
09/05/08 12:04 | UNDEFINED (,,,,) (U2292750) | Unreviewed
09/05/08 11:44 | UNDEFINED (,,,,) (U2292735) | Unreviewed
09/05/08 11:22 | UNDEFINED (,,,,) (U2292716) | Unreviewed
Show Selected Results
Show All Results
powered by HORIZON WP
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Trusted sites
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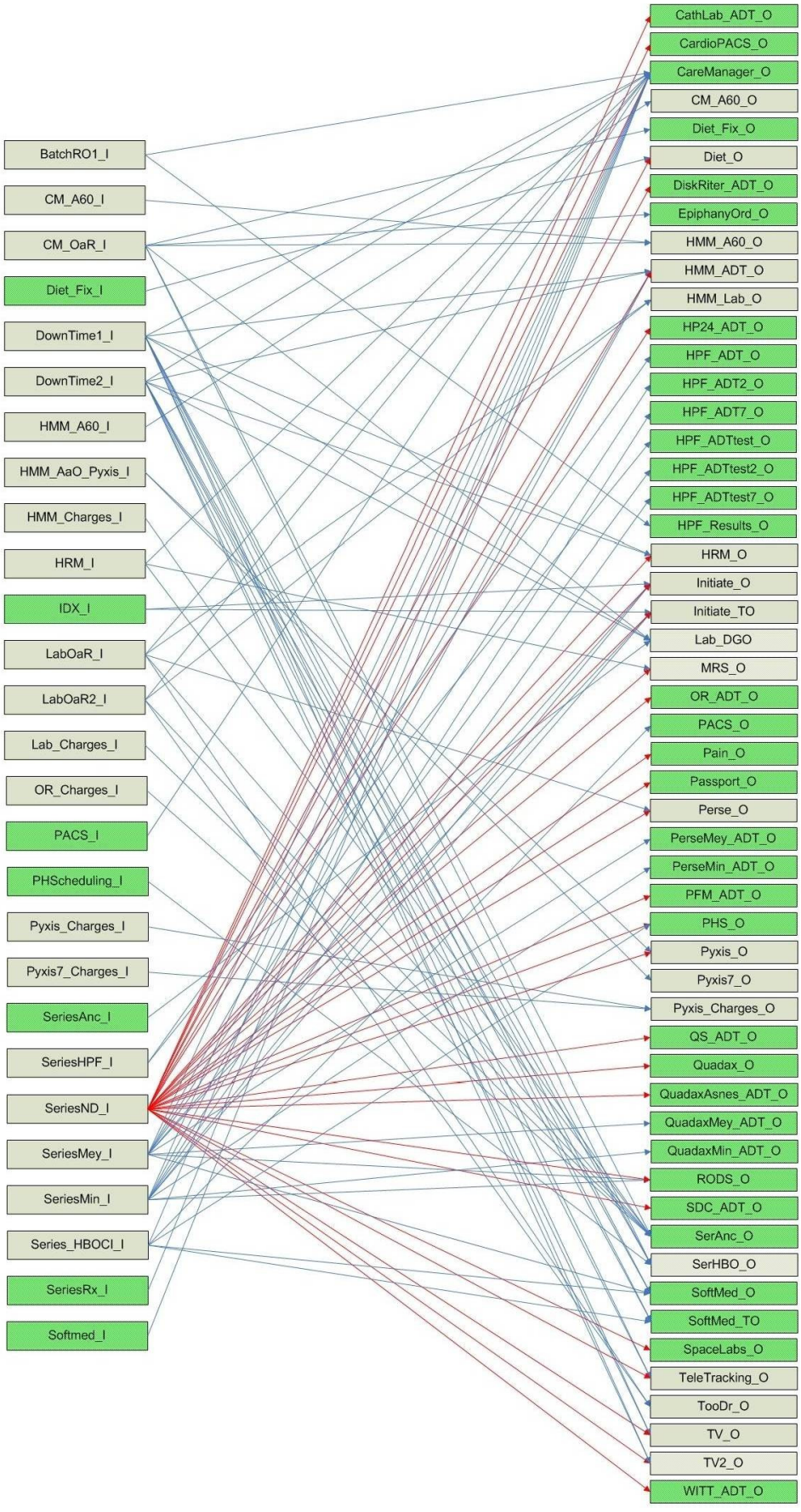
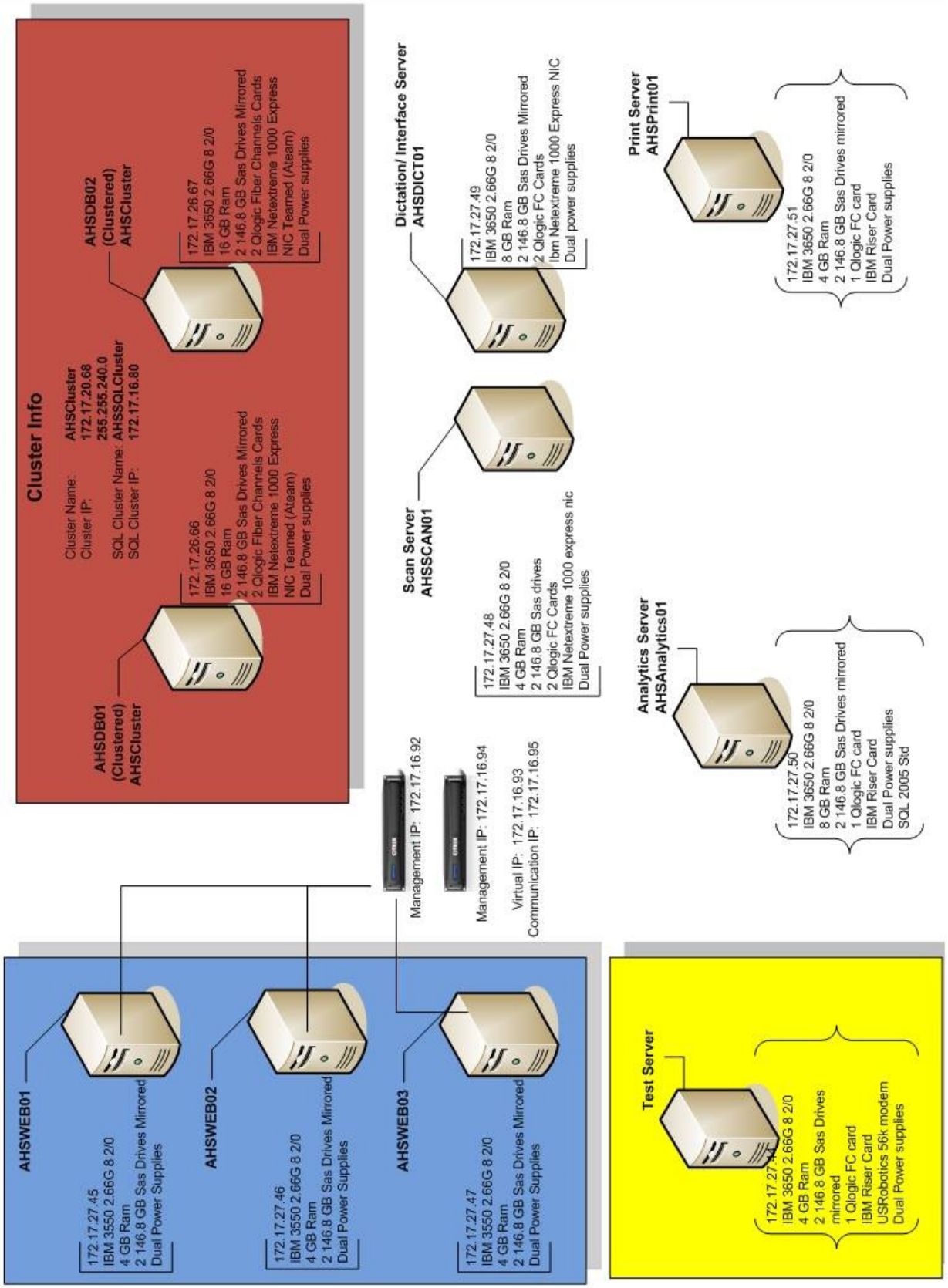
Inbox - Microsoft O...
Document1 - Micros...
HorizonWP Physicia...
3:14 PM

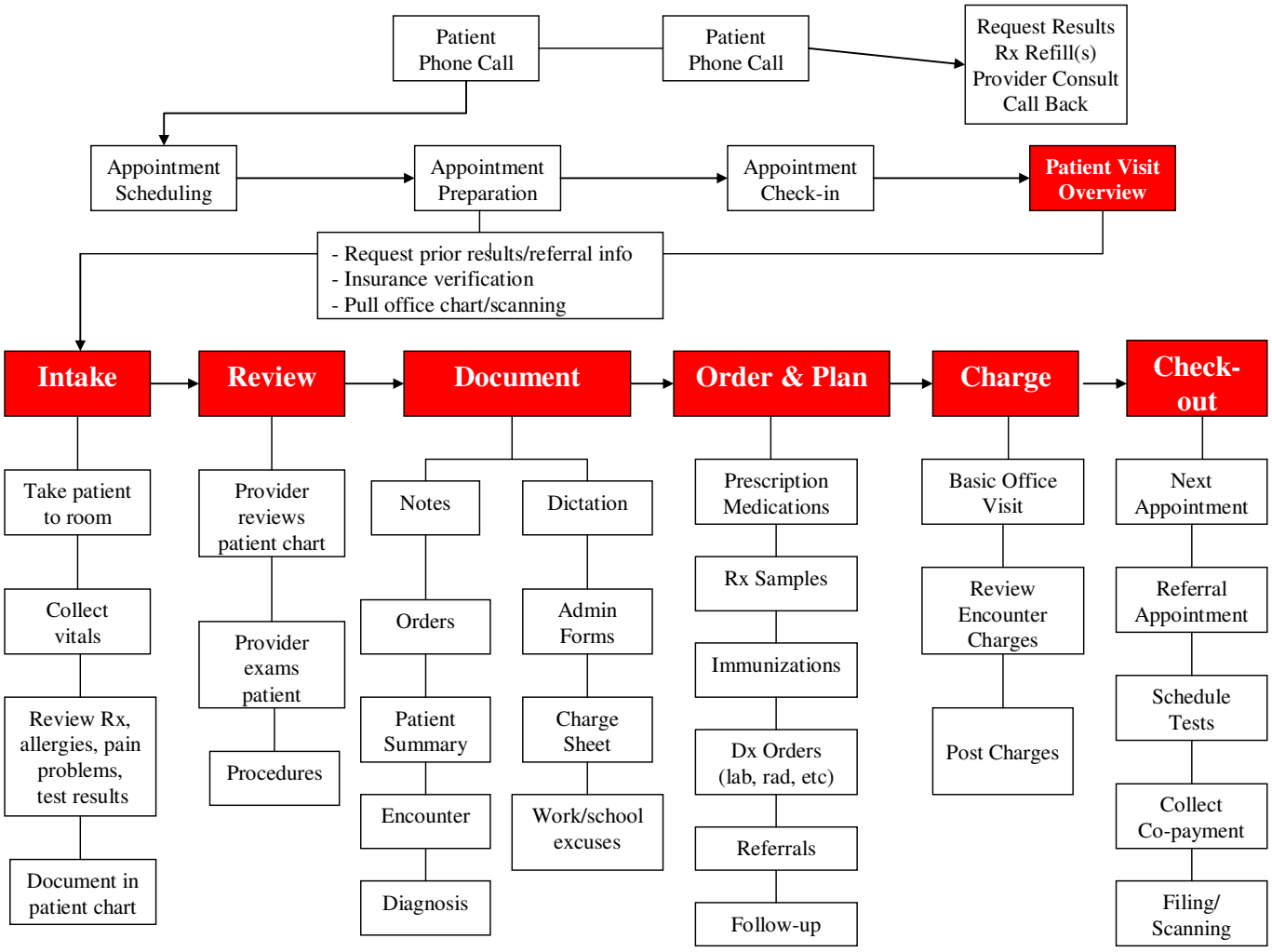
Appendix D: Cloverleaf Interface Threads



Appendix E: Allscripts Enterprise Electronic Health Record (EHR)



Appendix F: Physician Office Workflow



Appendix G: Physician HIT Survey Results

1. Please describe your affiliation with the Conemaugh Health System. (select only one)		
Answer Options	**Response Frequency**	**Response Count**
CHI FP or IM	25.6%	21
CHI Specialist or Hospital-based	24.4%	20
Independent - FP or IM	20.7%	17
Independent - Specialist	29.3%	24
answered question		**82**
skipped question		**0**

2. Does your practice or physician group utilize an Electronic Health Record (EHR)? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	36.6%	30
No	63.4%	52
answered question		**82**
skipped question		**0**

3. If you answered NO to the previous question, what constraints does your physician group or practice face? (select multiple boxes as needed)		
Answer Options	**Response Frequency**	**Response Count**
Financial	70.2%	33
Complexity	48.9%	23
Disrupt Workflow	36.2%	17
Not needed	21.3%	10
answered question		**47**
skipped question		**35**

4. What types of health information would be most useful for physicians to exchange? (select multiple boxes as needed)		
Answer Options	**Response Frequency**	**Response Count**
Patient Identification	74.4%	61
Medicine History	97.6%	80
Allergies	91.5%	75
Lab Results	87.8%	72
Radiology Reports	86.6%	71
Clinical Encounter Documentation	91.5%	75
answered question		**82**
skipped question		**0**

5. Does your practice or physician group currently use electronic Health Information Exchange (HIE) on a daily basis between CHS facilities? (select only one)

Answer Options	Response Frequency	Response Count
Yes	52.4%	43
No	47.6%	39
answered question		82
skipped question		0

6. If you answered Yes to question 5, do you feel that appropriate technical safeguards are in place to protect sensitive patient, physician and other data? (select only one)

Answer Options	Response Frequency	Response Count
Yes	89.7%	35
No	10.3%	4
answered question		39
skipped question		43

7. If you answered No to question 5, do you believe that HIE implementation at your practice could produce benefits (i.e. improve efficiency, save money, reduce medical errors, etc.)? (select only one)

Answer Options	Response Frequency	Response Count
Yes	63.9%	23
No	36.1%	13
answered question		36
skipped question		46

8. Among the key stakeholders in our service coverage area, there is consensus on the need for HIE? (select only one)

Answer Options	Response Frequency	Response Count
Agree	76.6%	59
Disagree	23.4%	18
answered question		77
skipped question		5

9. Did you utilize Health Information Technology (HIT) during your medical training (i.e. medical school, residency, fellowship, etc.)? (select only one)

Answer Options	Response Frequency	Response Count
Yes	19.8%	16
No	80.2%	65
answered question		81

skipped question	1

10. How difficult would it be to train staff at your physician practice or group practice to use a new EHR system? (select only one)

Answer Options	Response Frequency	Response Count
Easy	37.0%	30
Difficult	24.7%	20
Do not know	38.3%	31
answered question		81
skipped question		1

11. How difficult would it be to inform your patients about the benefits and responsibilities of a new EHR/HIE system? (select only one)

Answer Options	Response Frequency	Response Count
Easy	44.4%	36
Difficult	18.5%	15
Do not know	37.0%	30
answered question		81
skipped question		1

12. Do you agree that, among physicians in your community, it is becoming more common to utilize electronic health record systems? (select only one)

Answer Options	Response Frequency	Response Count
Yes	81.3%	65
No	18.8%	15
answered question		80
skipped question		2

13. Do you agree that adopting Electronic Health Records is essential for your physician practice or group practice to remain competitive in the healthcare industry? (select only one)

Answer Options	Response Frequency	Response Count
Yes	71.6%	58
No	28.4%	23
answered question		81
skipped question		1

14. Would you be interested in purchasing Electronic Health Record services for your practice from Conemaugh on a subscription basis if the price and service quality was competitive? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	21.5%	17
No	22.8%	18
Maybe	55.7%	44
answered question		**79**
skipped question		**3**

15. Do you find it frustrating that hospital-based providers and ambulatory care providers have trouble sharing medical records? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	79.0%	64
No	21.0%	17
answered question		**81**
skipped question		**1**

16. Has your largest health plan implemented a physician pay-for-performance program? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	50.0%	40
No	50.0%	40
answered question		**80**
skipped question		**2**

17. If you answered yes to question 16, does the P4P program directly reward adoption of health information technology? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	78.9%	30
No	21.1%	8
answered question		**38**
skipped question		**44**

18. Please use the following space to state additional comments on electronic medical records and health information exchange.	
Answer Options	**Response Count**
	27
answered question	**27**
skipped question	**55**

Appendix H – Hospital-based HIT Survey Results

1. Please state your position with Conemaugh Health System.(select only one)

Answer Options	Response Frequency	Response Count
Hospital Administrator	21.6%	37
Office Manager	19.3%	33
Physician Support(RN, LPN, PA, etc)	43.3%	74
Board Member	15.8%	27
answered question		171
skipped question		3

2. Does your health system currently use electronic Health Information Exchange (HIE) on a daily basis? (select only one)

Answer Options	Response Frequency	Response Count
Yes	59.5%	97
No	40.5%	66
answered question		163
skipped question		11

3. If you answered Yes to question 2, do you feel that appropriate technical safeguards are in place to protect sensitive patient, physician and other data? (select only one)

Answer Options	Response Frequency	Response Count
Yes	91.8%	89
No	8.2%	8
answered question		97
skipped question		77

4. Which benefits are most important to achieve through HIE implementation at Conemaugh? (select multiple boxes as needed)

Answer Options	Response Frequency	Response Count
Improve Efficiency	90.6%	155
Save Money	49.1%	84
Reduce Medical Errors	70.8%	121
Other	1.8%	3
answered question		171
skipped question		3

5. Do you believe HIE can be beneficial for Conemaugh Health System patients, providers, and administrators? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	97.7%	167
No	2.3%	4
answered question		171
skipped question		3

6. In your estimation, approximately what percent of local physician practices have adopted electronic health information technologies (e.g., electronic health records)?(select only one)		
Answer Options	**Response Frequency**	**Response Count**
Less than 10%	38.1%	61
10-25%	39.4%	63
More than 25%	22.5%	36
answered question		160
skipped question		14

7. Among the key stakeholders in our service coverage area, there is consensus on the need for HIE? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Agree	85.8%	145
Disagree	14.2%	24
answered question		169
skipped question		5

8. Do you agree that Health Information Exchange is essential for Conemaugh Health System to remain competitive in the healthcare industry? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Not Sure	7.6%	13
Yes	91.8%	157
No	0.6%	1
answered question		171
skipped question		3

9. Do you find it frustrating that hospital-based providers and ambulatory care providers have trouble sharing medical records? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	94.1%	159
No	5.9%	10
answered question		**169**
skipped question		**5**

10. Would you support new investment in HIE technologies throughout Conemaugh Health System? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	95.2%	160
No	4.8%	8
answered question		**168**
skipped question		**6**

11. Do you feel adoption of electronic medical records and HIE at Conemaugh will improve core healthcare outcomes (i.e. JCAHO, NCQA)? (select only one)		
Answer Options	**Response Frequency**	**Response Count**
Yes	94.7%	160
No	5.3%	9
answered question		**169**
skipped question		**5**

Appendix I – Military Healthcare Survey Results

1. Please select physician office.		
Answer Options	**Response Percent**	**Response Count**
MIMC Emergency Department	16.7%	2
MMC Emergency Department	8.3%	1
MYMC Emergency Department	33.3%	4
NORCAM Community Health Center	8.3%	1
Portage Health Center	33.3%	4
answered question		**12**
skipped question		**0**

2. On average, how many TRICARE beneficiaries do you provide care to on a monthly basis?		
Answer Options	**Response Percent**	**Response Count**
0-5	50.0%	6
5-10	33.3%	4
10-25	8.3%	1
25+	8.3%	1
answered question		**12**
skipped question		**0**

3. What percent of your average monthly patient visits are TRICARE beneficiaries?		
Answer Options	**Response Percent**	**Response Count**
0-5 %	75.0%	9
5-10 %	16.7%	2
10-25 %	0.0%	0
25+ %	8.3%	1
answered question		**12**
skipped question		**0**

4. On average, what percentage of TRICARE beneficiaries were patients before joining the military?		
Answer Options	**Response Percent**	**Response Count**
0-25 %	16.7%	2
26-50 %	8.3%	1
51-75 %	0.0%	0
76-100 %	0.0%	0
Not Sure	75.0%	9
answered question		**12**
skipped question		**0**

5. In what format do you prefer to review/use patient healthcare information?		
Answer Options	**Response Percent**	**Response Count**
Electronic Formats	75.0%	9
Hard-copy (Paper Formats)	25.0%	3
answered question		**12**
skipped question		**0**

6. In what format do you prefer to store active patient healthcare information?		
Answer Options	**Response Percent**	**Response Count**
Electronic Formats	75.0%	9
Hard-copy (Paper Formats)	25.0%	3
answered question		**12**
skipped question		**0**

7. Do you have access to the patient's healthcare information contained within the Military Health System (i.e. lab, radiology, medications)??		
Answer Options	**Response Percent**	**Response Count**
Always	0.0%	0
Sometimes	16.7%	2
Rarely	25.0%	3
Never	58.3%	7
answered question		**12**
skipped question		**0**

8. If applicable, how do you normally receive patient healthcare information contained within the Military Health System (MHS)? Select by order of frequency, most often to least often.

Answer Options	most often	frequently	occasionally	least often	Response Count
Electronic Medical Record (EMR)	1	1	2	5	9
Phone	2	1	5	1	9
Fax	4	4	0	2	10
Hand Delivery by Patient	3	3	1	2	9
				answered question	**10**
				skipped question	**2**

9. Does the frequency with which you need to contact TRICARE or its subcontractors negatively impact the operational cost of your office?		
Answer Options	**Response Percent**	**Response Count**
Yes	8.3%	1
No	41.7%	5
Not Sure	50.0%	6
answered question		**12**

skipped question	**0**

10. Does your current level of access to patient information contained within the TRICARE system negatively impact patient care?

Answer Options	Response Percent	Response Count
Yes	16.7%	2
No	50.0%	6
Not Sure	33.3%	4
answered question		**12**
skipped question		**0**

11. Has the lack of previous medical history resulted in: Select by order of frequency, most often to least often

Answer Options	most often	frequently	occasionally	least often	Response Count
Medical Errors	1	0	0	9	10
Delay in Care	1	3	6	0	10
Duplicate Tests	7	3	0	0	10
Increased Cost/Time	4	3	3	0	10
				answered question	**10**
				skipped question	**2**

12. On a scale of 1 (least) to 10 (most), how important do you feel a complete medical history is to their receipt of quality healthcare

Answer Options	Response Count
	12
answered question	**12**
skipped question	**0**

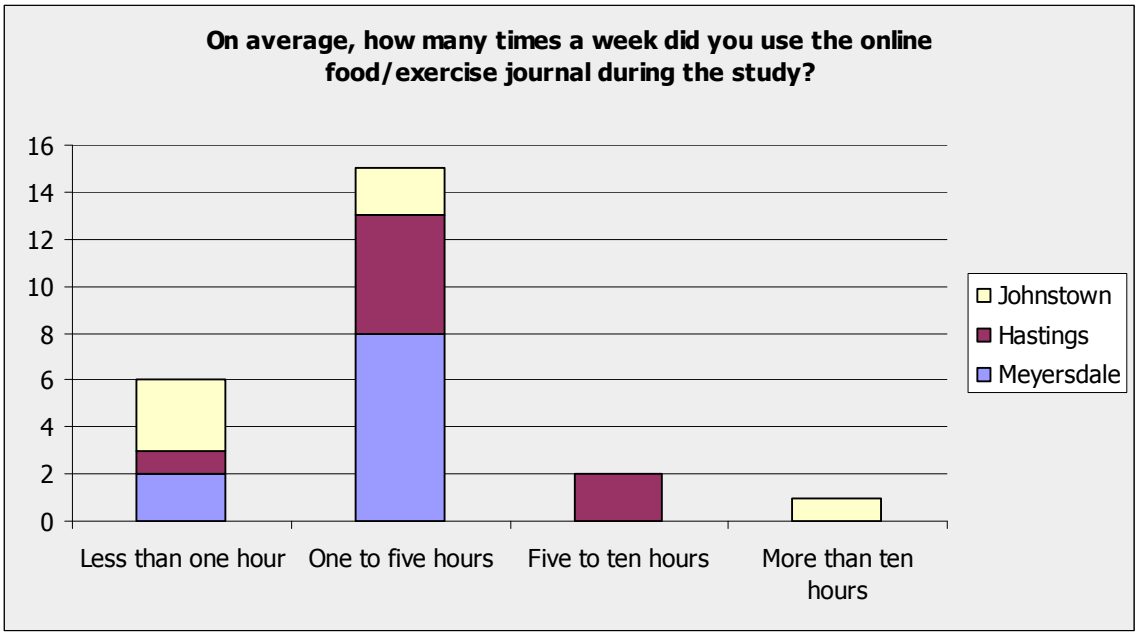
Number	Response Date	Response Text
1	**Mar 24, 2009 8:02 PM**	10
2	**Mar 25, 2009 8:00 PM**	10
3	**Mar 26, 2009 5:42 PM**	10
4	**Mar 27, 2009 2:02 PM**	5
5	**Mar 27, 2009 8:30 PM**	10
6	**Mar 30, 2009 5:15 PM**	9
7	**Mar 30, 2009 5:17 PM**	10
8	**Mar 30, 2009 5:19 PM**	10
9	**Mar 30, 2009 5:20 PM**	10
10	**Apr 1, 2009 5:02 PM**	10
11	**Apr 3, 2009 8:13 PM**	8
12	**Apr 13, 2009 6:14 PM**	10

13. How often do you have to contact the TRICARE Service Center for additional patient information?		
Answer Options	**Response Percent**	**Response Count**
Always	8.3%	1
Sometimes	33.3%	4
Rarely	0.0%	0
Never	33.3%	4
Do not have time	25.0%	3
answered question		**12**
skipped question		**0**

14. Do you believe the electronic exchange of healthcare information between the MHS and private sector providers will meaningfully improve the continuity of care for beneficiaries?		
Answer Options	**Response Percent**	**Response Count**
Yes	75.0%	9
No	0.0%	0
Not Sure	25.0%	3
answered question		**12**
skipped question		**0**

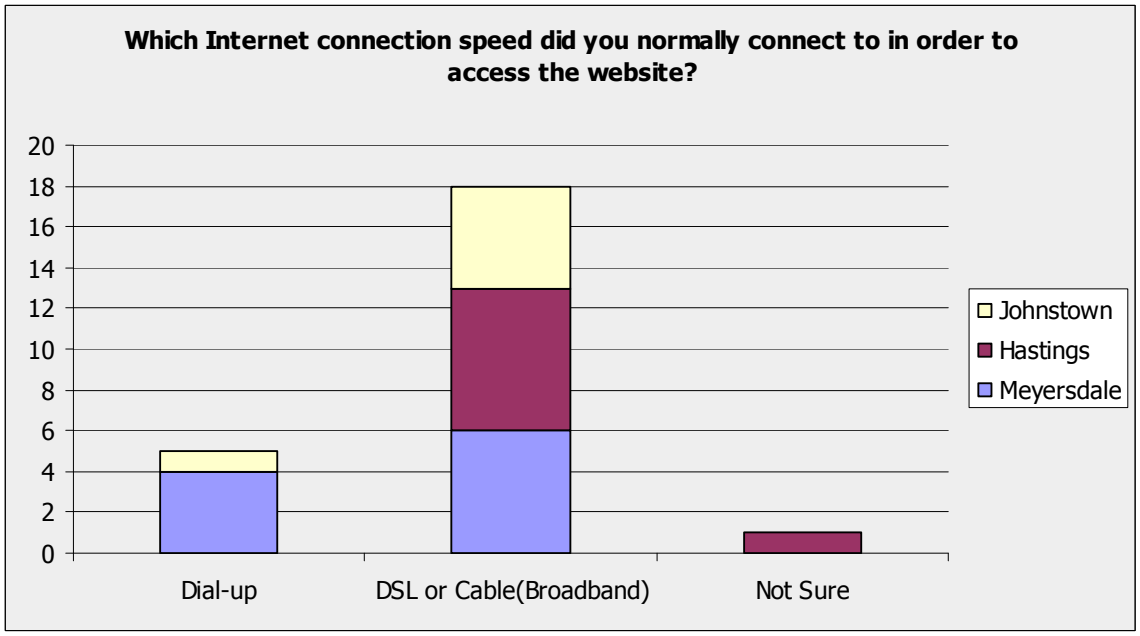
15. Would you welcome the implementation of an electronic system that would enable you to directly access patient healthcare information?		
Answer Options	**Response Percent**	**Response Count**
Yes	75.0%	9
No	0.0%	0
Not Sure	25.0%	3
answered question		**12**
skipped question		**0**

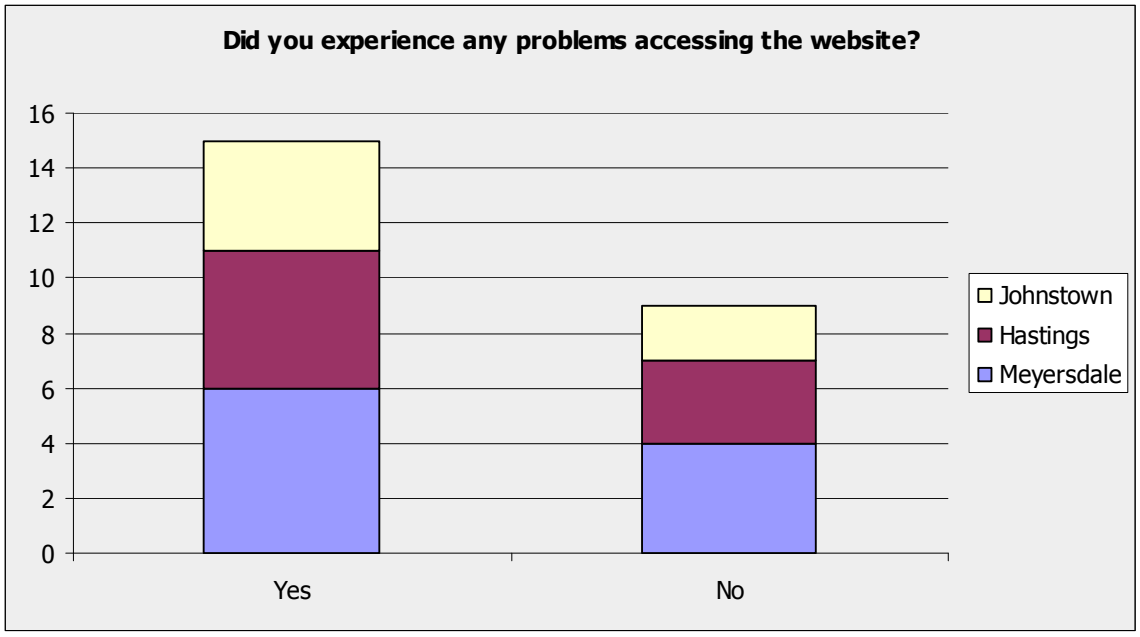
Appendix J - Nutrition & Fitness Journal Surveys



In a typical week, how many hours do you spend using the Internet?

	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Never	0	1	1	8.3%	2
1-10 hours	4	5	8	70.8%	17
11-20 hours	2	1	1	16.7%	4
21-30 hours	0	0	0	0.0%	0
30+ hours	0	1	0	4.2%	1
				answered question	**24**
				skipped question	**0**


Which Internet connection speed did you normally connect to in order to access the website?
20
18
16
14
12
10
8
6
4
2
0
Dial-up
DSL or Cable(Broadband)
Not Sure
Johnstown
Hastings
Meyersdale


Did you experience any problems accessing the website?
16
14
12
10
8
6
4
2
0
Yes
No
Johnstown
Hastings
Meyersdale

User Friendliness

Answer Options	Please circle your group: Johnstown	Hastings	Meyersdale	Response Percent	Response Count
1 - Poor	0	1	1	8.3%	2
2	1	1	1	12.5%	3
3	1	1	3	20.8%	5
4	2	3	2	29.2%	7
5 - Excellent	2	2	3	29.2%	7
				answered question	**24**
				skipped question	**0**

Picture Quality

Answer Options	Please circle your group: Johnstown	Hastings	Meyersdale	Response Percent	Response Count
1 - Poor	0	0	0	0.0%	0
2	1	1	1	12.5%	3
3	0	2	3	20.8%	5
4	3	1	2	25.0%	6
5 - Excellent	2	4	4	41.7%	10
				answered question	**24**
				skipped question	**0**

Ease of navigation of the website

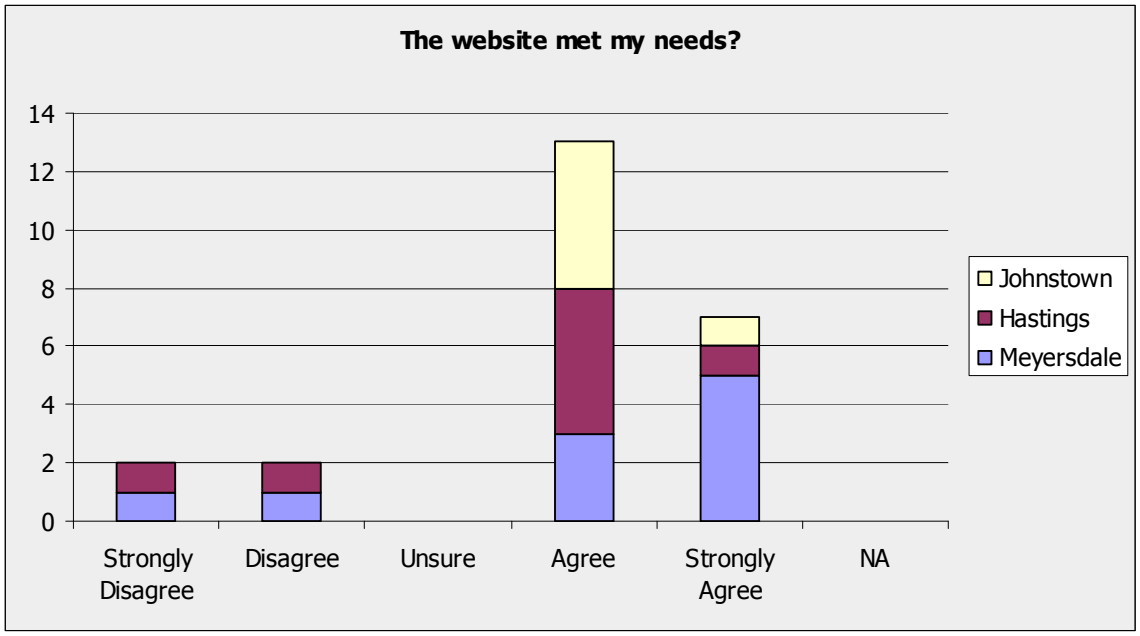
Answer Options	Please circle your group: Johnstown	Hastings	Meyersdale	Response Percent	Response Count
1 - Poor	0	1	0	4.2%	1
2	0	0	1	4.2%	1
3	1	2	3	25.0%	6
4	4	3	3	41.7%	10
5 - Excellent	1	2	3	25.0%	6
				answered question	**24**
				skipped question	**0**

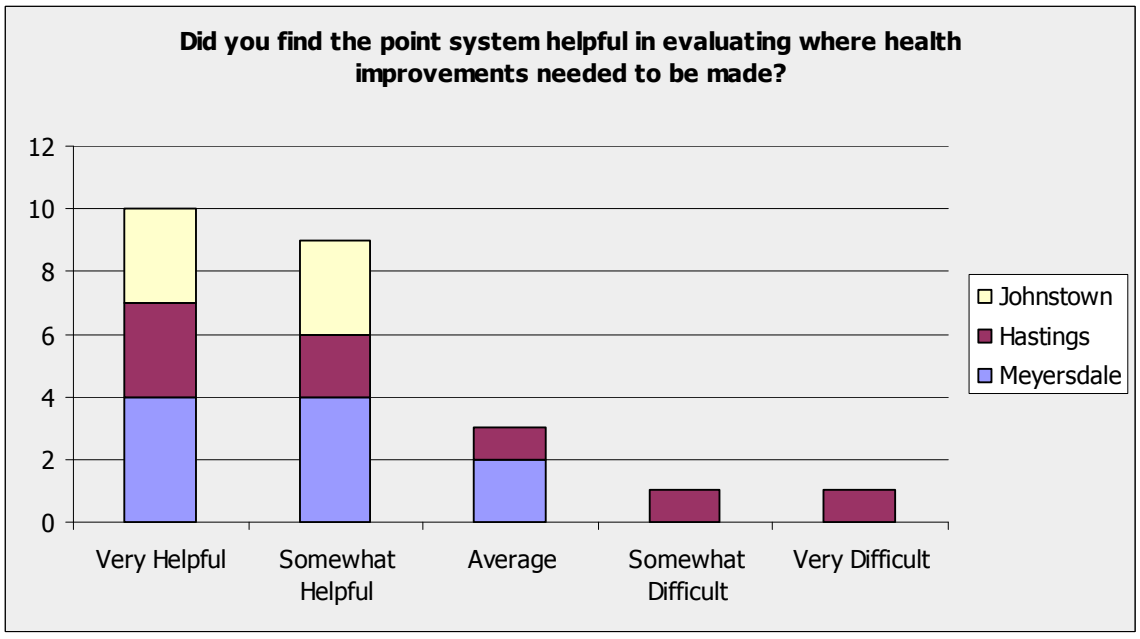
How easy is it to find your way around the website?

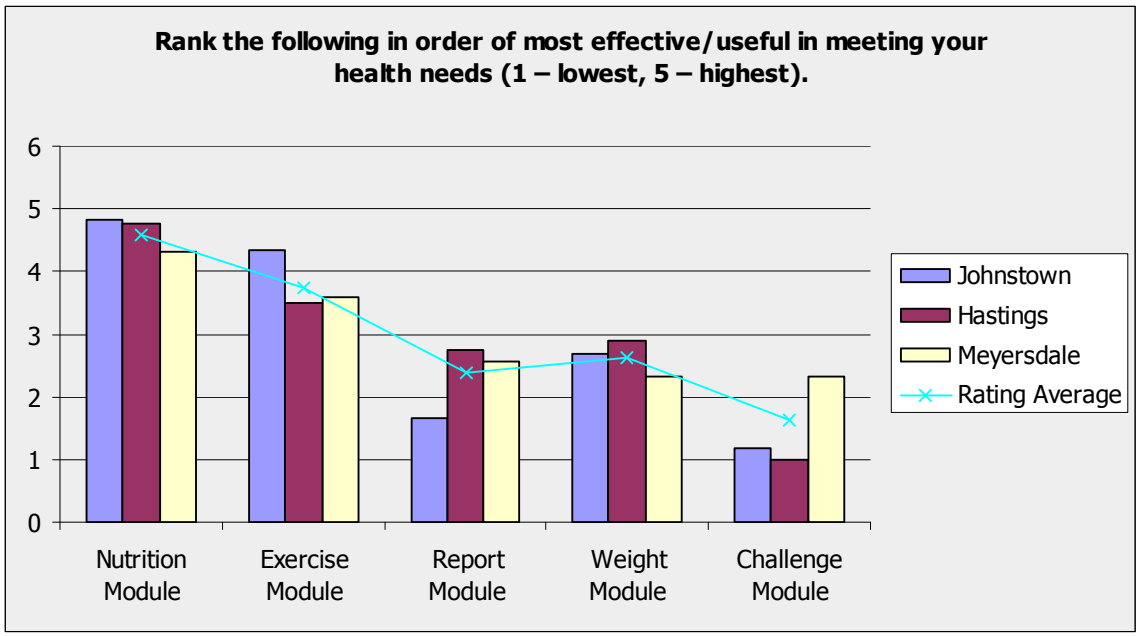
	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Very Easy	1	4	2	29.2%	7
Somewhat Easy	4	1	4	37.5%	9
Average	1	2	4	29.2%	7
Somewhat Difficult	0	0	0	0.0%	0
Very Difficult	0	1	0	4.2%	1
				answered question	**24**
				skipped question	**0**

The layout of the website is well-organized and clear?

	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Strongly Disagree	0	2	0	8.3%	2
Disagree	0	0	1	4.2%	1
Unsure	0	0	0	0.0%	0
Agree	5	5	5	62.5%	15
Strongly Agree	1	1	4	25.0%	6
NA	0	0	0	0.0%	0
				answered question	**24**
				skipped question	**0**


The website met my needs?
14
12
10
8
6
4
2
0
Strongly Disagree
Disagree
Unsure
Agree
Strongly Agree
NA
Johnstown
Hastings
Meyersdale


Did you find the point system helpful in evaluating where health improvements needed to be made?
12
10
8
6
4
2
0
Very Helpful
Somewhat Helpful
Average
Somewhat Difficult
Very Difficult
Johnstown
Hastings
Meyersdale



Did you find the summary charts and graphs (e.g. exercise summary) helpful?

	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Very Helpful	1	1	4	25.0%	6
Somewhat Helpful	5	3	4	50.0%	12
Average	0	2	2	16.7%	4
Somewhat Difficult	0	1	0	4.2%	1
Very Difficult	0	1	0	4.2%	1
				answered question	**24**
				skipped question	**0**

Did you have to contact Joe Shetler, exercise physiologist, to request additional foods and exercises to be added to the current list?

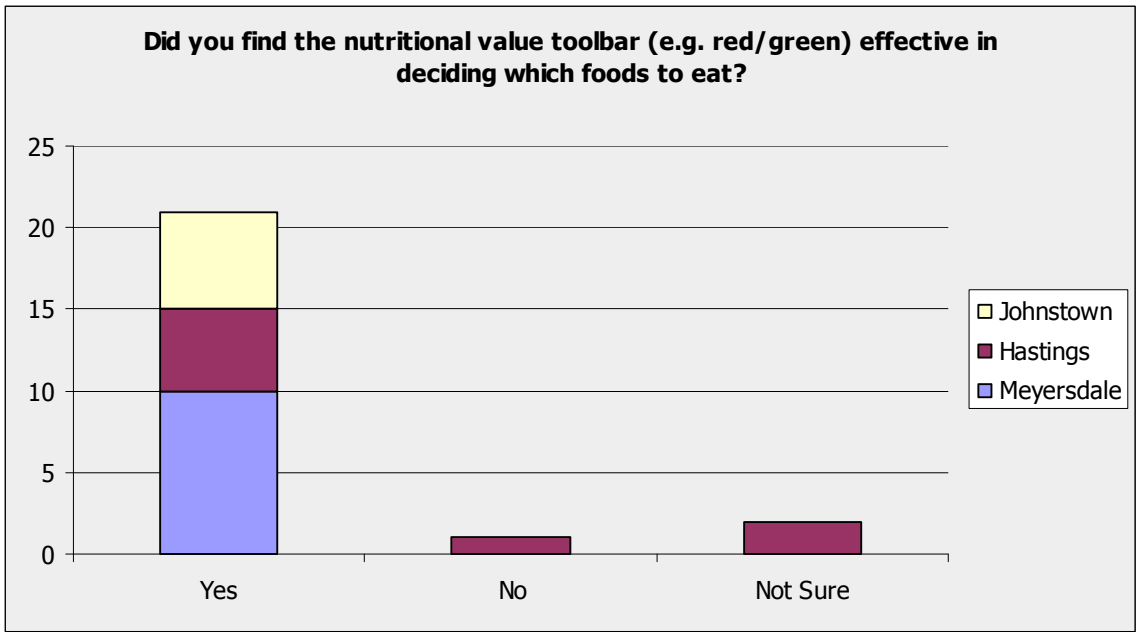
	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Yes	4	7	8	79.2%	19
No	2	1	2	20.8%	5
				answered question	**24**
				skipped question	**0**

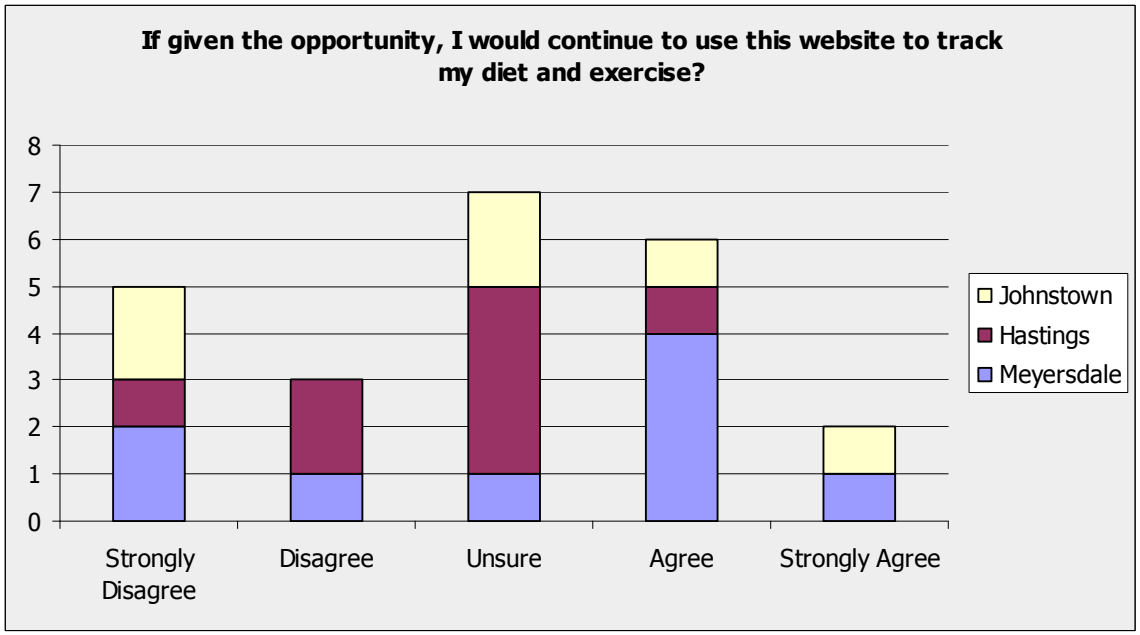
If you answered Yes to the Question 14, how many requests did you make?

	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Food	4	6	9	95.0%	19
Exercise	3	6	10	95.0%	19
			answered question		**20**
			skipped question		**4**

Did you find the "Net Caloric Intake Goal" effective in meeting your health needs?

	Please circle your group:				
Answer Options	**Johnstown**	**Hastings**	**Meyersdale**	**Response Percent**	**Response Count**
Strongly Disagree	0	1	0	4.2%	1
Disagree	0	0	1	4.2%	1
Unsure	0	1	0	4.2%	1
Agree	3	5	5	54.2%	13
Strongly Agree	3	1	4	33.3%	8
			answered question		**24**
			skipped question		**0**


Did you find the nutritional value toolbar (e.g. red/green) effective in deciding which foods to eat?
25
20
15
10
5
0
Yes
No
Not Sure
Johnstown
Hastings
Meyersdale


If given the opportunity, I would continue to use this website to track my diet and exercise?
8
7
6
5
4
3
2
1
0
Strongly Disagree
Disagree
Unsure
Agree
Strongly Agree
Johnstown
Hastings
Meyersdale